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REPORT OF THE INTERNATIONAL ICE PATROL SERVICE IN THE NORTH ATL--ETC(U)
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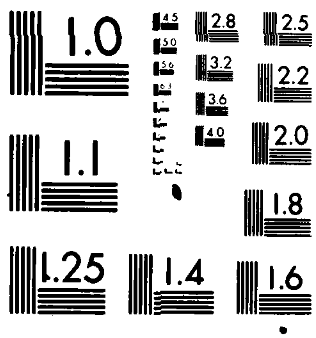

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NATIONAL BUREAU OF STANDARDS 1963-A

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DEPARTMENT OF TRANSPORTATION

COAST GUARD

AD A113555

BULLETIN NO. 66

Report of the International Ice Patrol Service in the North Atlantic Ocean

1979-ID 1093073

SEASON OF 1980

CG-188-35

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Atlantic Area, U.S. Coast Guard
Governors Island
New York, NY 10004

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16. Abstract

This is 66th in a series of annual reports on the Internatioal Ice Patrol Service in the North Atlantic Ocean. Information on ice conditions and Ice Patrol operations for 1980 is contained in this report.

The Marine Sciences and Ice Operations Branch of the Commander, U.S. Coast Guard Atlantic Area prepares this report and acknowledges the assistance and information porvided by the Atmospheric Environment Service of Environment Canada, the U.S. National Weather Service, the U.S. Naval Oceanographic Office, the U.S. Coast Guard Oceanographic Unit, and the U.S. Research and Development Center.

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18 MAR 1981

Bulletin No. 66

REPORT OF THE INTERNATIONAL ICE PATROL SERVICES IN THE NORTH ATLANTIC OCEAN

Season of 1980

CG-188-35

FOREWARD

Forwarded herewith is Bulletin No. 66 of the International Ice Patrol describing the Patrol's services, and ice observations and conditions during the 1980 season.

John D. Costello

JOHN D. COSTELLO
Chief, Office of Operations

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PREFACE

This is the 66th in a series of annual reports on the International Ice Patrol Service in the North Atlantic Ocean. Information on ice conditions and Ice Patrol operations for 1980 is contained in this report.

The Marine Sciences and Ice Operations Branch of the Commander, U.S. Coast Guard Atlantic Area prepares this report and acknowledges the assistance and information provided by the Atmospheric Environment Service of Environment Canada, the U.S. National Weather Service, the U.S. Naval Oceanographic Office, the U.S. Coast Guard Oceanographic Unit, and the U.S. Coast Guard Research and Development Center.

We take this opportunity to extend our sincere appreciation to the staff of Canadian Coast Guard Radio Station St. John's Newfoundland/VON and the St. John's weather forecasting office for their continued excellent support during the 1980 Ice Patrol Season.

INTERNATIONAL ICE PATROL 1980

The U.S. Coast Guard conducted the 1980 International Ice Patrol service in the North Atlantic Ocean under the provisions of Title 46, U.S. Code, Sections 738, 738a through 738d, and the International Convention for the Safety of Life at Sea (SOLAS) 1960, regulations 5-8. During the 1980 season, the International Ice Patrol disseminated information to the mariner on the ice conditions near the Grand Banks of Newfoundland, Northwest Atlantic Ocean. To achieve this, the Coast Guard patrolled the southeastern, southern, and southwestern limits of iceberg drift, and maintained a plot on the extent of these limits.

Commander, U.S. Coast Guard Atlantic Area is Commander, International Ice Patrol and directed the 1980 operations from the Ice Patrol Office located at Governors Island, New York, New York. Vice Admiral Robert I. Price, U.S. Coast Guard, was Commander International Ice Patrol. The Ice Patrol Officer was Commander Jerry C. Bacon, U.S. Coast Guard, who with his staff officers and men of the Marine Sciences Branch, conducted Ice Patrol Operations. The office analyzed ice and environmental data and prepared the daily ice bulletins and facsimile chart. All Coast Guard units deployed on Ice Patrol missions came under the operational control of Commander, International Ice Patrol.

Preseason reconnaissance flights in January and February 1980 were used to determine the starting date of the 1980 season. The Ice Patrol season officially commenced on 7 March 1980. An aerial Ice Reconnaissance Detachment operated from St. John's, Newfoundland until 4 July 1980.

USCGC EVERGREEN was utilized from 27 May 1980 through 26 June for Ice Patrol operations. From 27 May through 17 June, EVERGREEN conducted iceberg drift and deterioration studies, while from 22 June through 26 June EVERGREEN was assigned duties as surface patrol cutter to monitor the southeasternmost berg then on plot, and tracked its drift and deterioration, noting sea surface temperature and weather.

During the 1980 season, an estimated 23 bergs and growlers drifted south of 48-00N. Table 1 shows monthly estimates for 1980 and previous years.

Table 1—ESTIMATED NUMBER OF ICEBERGS SOUTH OF LATITUDE 48-00N, 1980 SEASON

	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	TOTAL
1980	0	0	0	0	1	3	7	0	9	4	0	0	24
TOTAL 1946–1980	10	2	4	11	65	272	1107	3060	2975	1771	486	100	9863
AVERAGE 1946–1980	0	0	0	0	2	8	32	90	88	52	14	3	282
TOTAL 1900–1980	256	109	110	91	185	724	3209	7905	10058	5289	1682	489	30107
AVERAGE 1900–1980	3	1	1	1	2	9	40	99	126	66	21	21	377

AERIAL ICE RECONNAISSANCE

During the 1980 Ice Patrol Season (considered from 1 September 1979 through 31 August 1980) there were 42 aircraft sorties flown in support of International Ice Patrol. These included preseason surveys, ice observation flights, and logistics flights. Table 2 shows aircraft utilization during the 1980 season.

The number of flights is lower than in previous years due to the light concentration of bergs for this season and an attempt to increase the efficency of the ice reconnaissance technique. Once an initial berg concentration and limit of all known ice was established, a series of patrols, near the projected limit with up to a sixty mile safety zone on both sides, was flown. With firmly established ice limits and positions of bergs nearest the limits known, only occasional "survey" flights during the season were conducted. This insured an adequate knowledge of berg concentrations and movement to the north of the Grand Banks, while maintaining an accurate limit of all known ice.

U.S. Coast Guard C-130 "HERCULES" aircraft from Coast Guard Air Station Elizabeth City, North Carolina were used to conduct aerial reconnaissance. While deployed on Ice Reconnaissance Detachment, these aircraft operated from St. John's, Newfoundland.

Table 2—Aerial Ice Reconnaissance, 1 September 1979-31 August 1980

	SORTIES	HOURS
PRESEASON	9	40.1
INSEASON	33	160.9
POSTSEASON	0	0

COMMUNICATIONS

USCG Communications Station NMF/NIK, Boston, MA was the primary radio station used for the dissemination of the daily ice bulletin and facsimile chart after preparation by the Ice Patrol office in New York. Other transmitting stations included Canadian Coast Guard Radio Station VON, St. John's, Newfoundland, Canadian Forces Radio Station CFH, Mill Cove, and U.S. Navy LCMP broadcast stations NAM, Norfolk; Thurso, Scotland; and Keflavik, Iceland.

Canadian Forces Station CFH, Mill Cove as well as HM Radio Station GFE, Bracknell, UK were radiofacsimile broadcasting stations which used Ice Patrol limits in their broadcasts. Special broadcasts were provided by Canadian Coast Guard Radio Station VON, St. John's.

The Ice Patrol Office requested all ships to report ice sightings, weather, and sea surface temperatures via USCG Communications Station NMF/NIK, Boston. Response to this request is shown in Table 3. The five most frequent contributors of this information during the 1980 Ice Patrol season were:

USCGC EVERGREEN/NRXD
M/V BURAFOSS/TFLA
M/V ZIEMIA OLSZTYNSKA/SQDR
M/V RIVERINA/GUUC
CTU 302.2.3

Appendix A lists all contributors.

Table 3

Number of ships furnishing SST reports	27
Number of SST reports received	215
Number of ships furnishing ice reports	24
Number of aircraft furnishing ice reports	2
Number of ice reports received	45

Table 4 Ice Patrol Broadcasts, 1980

First ice bulletin	070000Z MAR 80
Last ice bulletin	040000Z JUL 80
Number of bulletins broadcast	241
Number of facsimile charts broadcast	120

NOTE: There were three safety broadcasts made prior to the official commencement of the 1980 season during January.

ICE AND ENVIRONMENTAL CONDITIONS

September-October 1979

No iceberg sighting reports were received by Ice Patrol during these months. No sea ice was reported south of 62–00N (figures (1) and (2)). Figures (3) and (4) depict the sea surface atmospheric pressure averages for these months, showing near normal conditions, with westerlies prevailing. Temperatures were also near normal.

November 1979

No sea ice was present south of 62-00N for most of the month. Figure (5) shows sea ice formation for mid-November. However gradual formation along the Labrador coast began late in the month. No iceberg reports were received in November. The Icelandic low was deeper than normal (figure (6)), with an intensification of northwesterly winds over Labrador. Temperatures were slightly below normal for Newfoundland and Labrador during November, with heavy snowfall experienced in western Newfoundland.

December 1979

Sea ice continued its southward growth, extending to the Straits of Belle Isle by mid-December (figure (8)). Ice Central Ottawa reported a few bergs nearing the approaches to the Straits of Belle Isle, a common occurance for this time of year. Figure (7) depicts the mean surface pressure for December. Readily apparent is the deeper than normal Icelandic low, with prevailing northwesterly winds partially explaining the noticeable sea ice growth. A major storm of hurricane intensity passed across the region on 17 December, bringing record winds to much of the Maritimes, and record precipitation, mostly rain. The exception was coastal Labrador, which experienced significant snowfall. Except for Labrador, temperatures were slightly above normal for the region.

January 1980

Through January, sea ice grew farther southward, extending from the ice covered Straits of Belle Isle to White Bay and Notre Dame Bay (figure (9)). Fast ice was reported along the Labrador coast in most bays and inlets. The Icelandic low remained deeper than normal (figure (10)), in part due to the passage of a severe storm on 12-13 January and another on 23-24 January. These storms were characterized by heavy precipitatation and high winds, however, over the entire month the weather was generally sunny and dry with seasonable temperatures. Ice Patrol received its first iceberg sightings in January. On 21 January, a Canadian Forces aircraft sighted a medium sized berg at 48-10N 45-30W, and on 25 January a vessel sighted a small berg at 47-40N 47-40W. These sightings were the easternmost and southernmost sightings for the 1980 season. An extensive preseason survey resulted from these sightings, but the bergs were not resighted.

February 1980

Sea ice growth through February reached 47-00N and up to 100 miles offshore of the Avalon Peninsula. The sea ice limits of mid-February are shown in figure (12). The Icelandic low remained deeper than normal (figure (11)), again due to the passage of numerous storms. These storms brought to the Grand Banks a total of fifteen days when the winds were from the southern quadrant. Temperatures for Newfoundland were slightly below normal, but in northern Labrador the opposite was true. Precipitation was well below normal for the entire region, in spite of the storms experienced. Three bergs were reported crossing 48-00N during February (figure (13)), with numerous bergs observed approaching 48-00N late in the month.

March 1980

Sea ice limits began a retreat to the north in early March. Through the middle of the month this limit extended eastward somewhat, however the concentration of sea ice near the extreme southern and eastern ice edge diminished (figure (14)) due in part to a major storm passing the region on 12-14 March. Late in the month, another severe storm crossed the region, further diminishing the concentration, and causing a retreat of the ice edge to north of Cape Freels. Surface pressure was well above normal for March (figure (15)), and no single predominant wind flow stood out. Temperatures were slightly above normal for Newfoundland, and

March 1980 (cont'd)

averaged 2 degrees (C) above normal for Labrador. Precipitation was greater than normal for the region, the majority of which fell during the two storms previously mentioned.

Figure (17) shows berg conditions for the first week in March, while figure (18) is the result of a flight on 8 March. A comparison indicates the berg drift, however many of the bergs and growlers melted before they reached the Grand Banks. Seven bergs were reported as crossing 48-00N during March, with others found to the north and west of the Grand Banks in late March (figure (19)). Figure (20) shows the drift at the end of the month, with no bergs or growlers south of 49-00N.

April 1980

Sea ice continued its retreat, with the eastern limit of the ice edge diminishing in concentration to bands and strips (figure (21)). Average surface pressure continued to be much higher than normal (figure (16)) with some stations setting record high pressures. Overall, weather was fairly pleasant, with St. John's averaging near normal temperatures. Snowfall was far below normal, setting a new record low. Again, no predominant wind flow was observed over the Grand Banks for the month. No bergs or growlers were reported south of 48-00N during April, with 21 bergs and growlers to the north of the Grand Banks. At the end of the month, berg concentration was very light, with a few bergs remaining north and west of the Banks (figure (23)).

May 1980

During May the sea ice edge continued its retreat. Figure (24) shows conditions in mid-May, with the southern ice limit near St. Anthony. Reduced concentrations are noted, indicative of the gradual decay. For the month, average surface pressures were slightly below normal (figure (25)) with no predominant wind flow. Precipitation was highter than normal in Newfoundland, with Gander reporting a record of 149.1 mm. Temperatures averaged from 2 degrees (C) above normal in western Labrador to 1.5 degrees (C) below normal at Prince Edward Island. Nine bergs were reported south of 48-00N during May. Figure (27) shows berg conditions of 3 May. The concentration north of 49-00N is noted. By mid-May many of these bergs had drifted south as shown in figure (28). By the end of the month, most of these had melted, leaving a few bergs along the Newfoundland coast and two to the east as indicated in figure (29).

June 1980

Sea ice decay continued through the month. By mid-June the southern ice edge was near Groswater Bay (figure (30)). Average surface pressures were higher than normal, with southwesterly winds predominating (figure (26)).

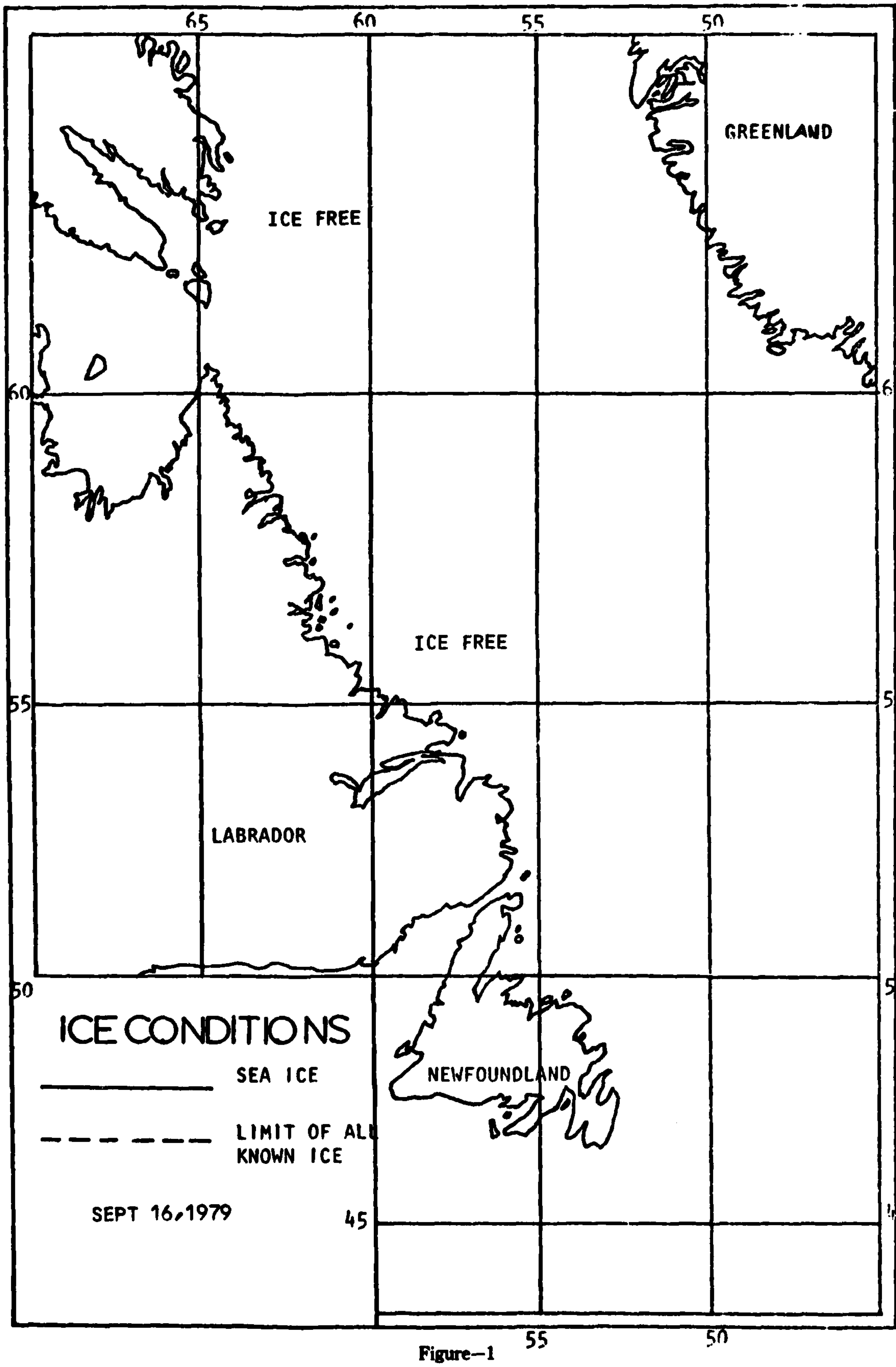
Precipitation over the Maritimes was near normal. Temperatures were slightly below normal at St. John's, while the rest of the region had slightly warmer temperatures. Four bergs were reported to cross 48-00N during the first week of June. Mid-month saw few bergs remaining (figure (31)), most having melted due to the warming of the water. Sea surface isotherms are illustrated in figure (32). The end of the month showed that the only bergs remaining were north of 49-00N, well north of the Grand Banks (figure (33)).

July 1980

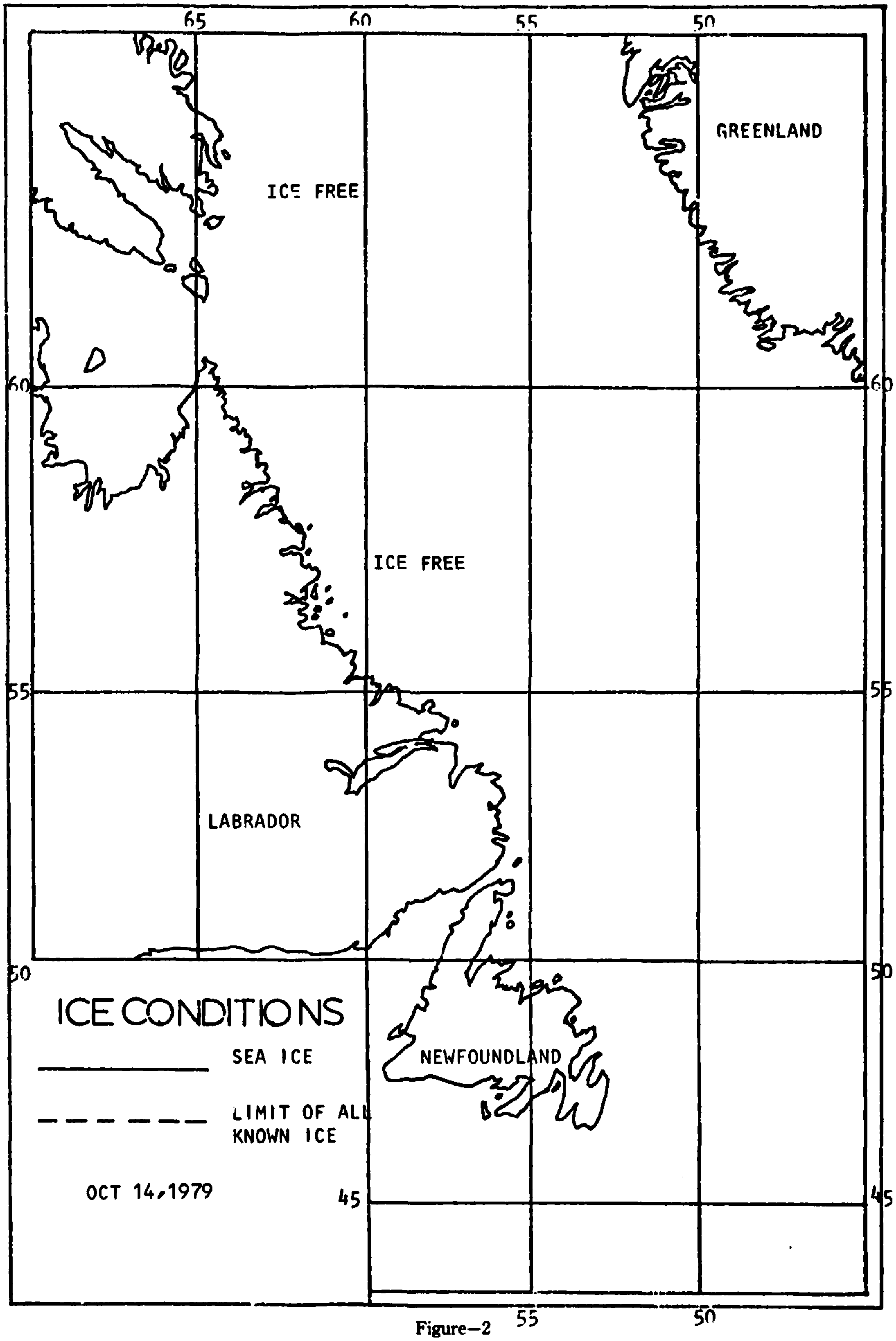
Decay had taken its toll on the remaining sea ice, with the southernmost ice remaining in Ungava Bay and near Cape Chidley, as shown in figure (34). Surface pressure averages remained higher than normal (figure (35)), with a prevailing southwesterly flow over the Grand Banks. Precipitation was slightly higher than normal over Newfoundland and Labrador, with temperatures relatively warm over the region, except for St. John's. No bergs were reported to cross 48-00N during July. Early July found a few bergs north of 49-00N (figure 37), but these melted in the warm water. Ice Patrol continued to receive sighting reports through the month, with most bergs sighted near the approaches to the Strait of Belle Isle.

August 1980

No sea ice was reported south of 62-00N during August (figure (38)). Surface pressure averaged below normal, with no predominant wind flow (figure (36)). Temperatures were slightly above normal for the region during August, while precipitation was near normal. Occasional berg sightings were received by Ice Central Ottawa, all to the north of the Straits of Belle Isle.


65
60
55
50
GREENLAND
ICE FREE
ICE FREE
LABRADOR
NEWFOUNDLAND
60
55
50
45
ICE CONDITIONS
SEA ICE
LIMIT OF ALL KNOWN ICE
SEPT 16, 1979

Figure—1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GREENLAND
ICE FREE
ICE FREE
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LABRADOR
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ICE CONDITIONS
SEA ICE
LIMIT OF ALL
KNOWN ICE
NEWFOUNDLAND
OCT 14,1979
45
45
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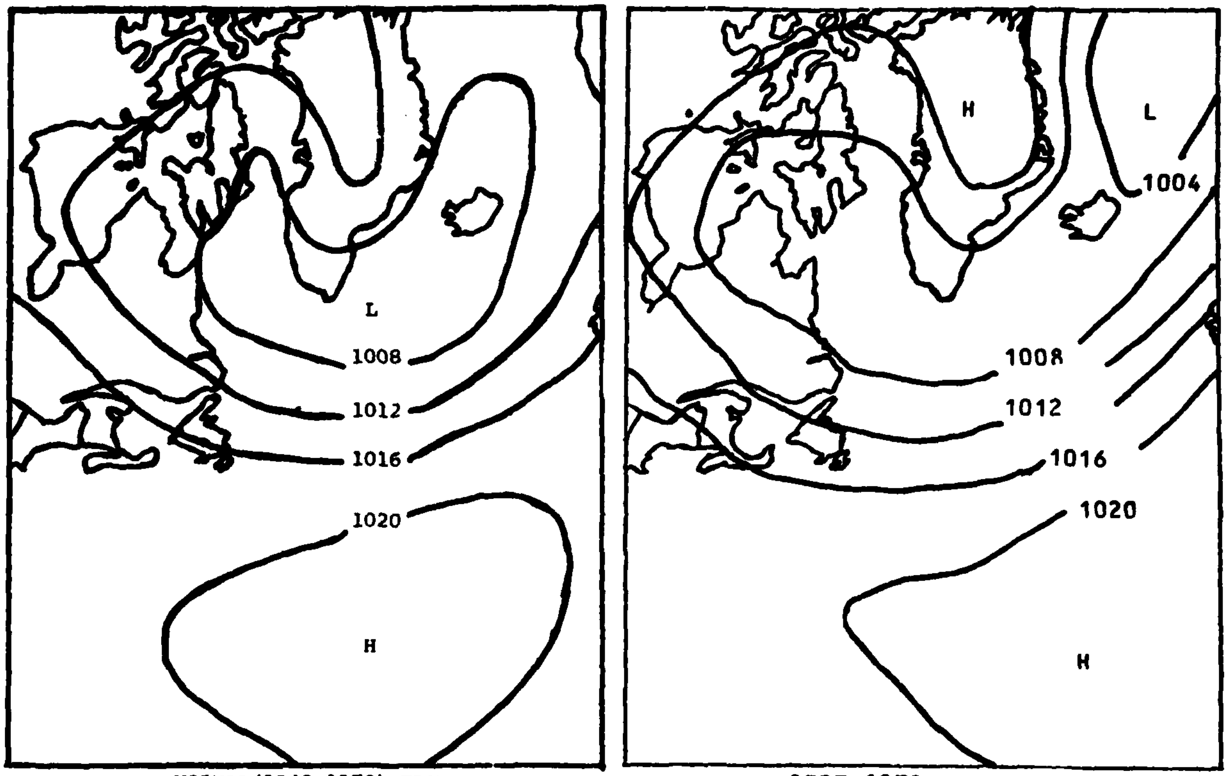
50

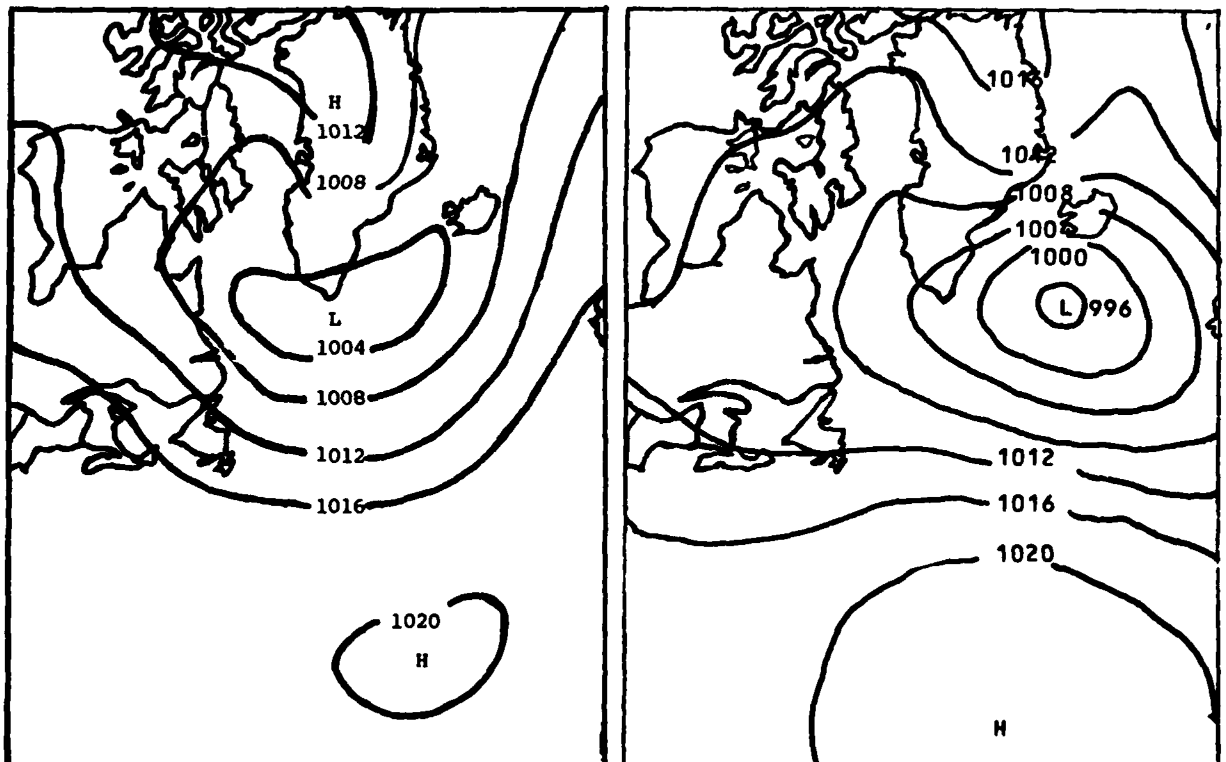
Figure—2



NORMAL (1948-1970) SEPT

SEPT 1979

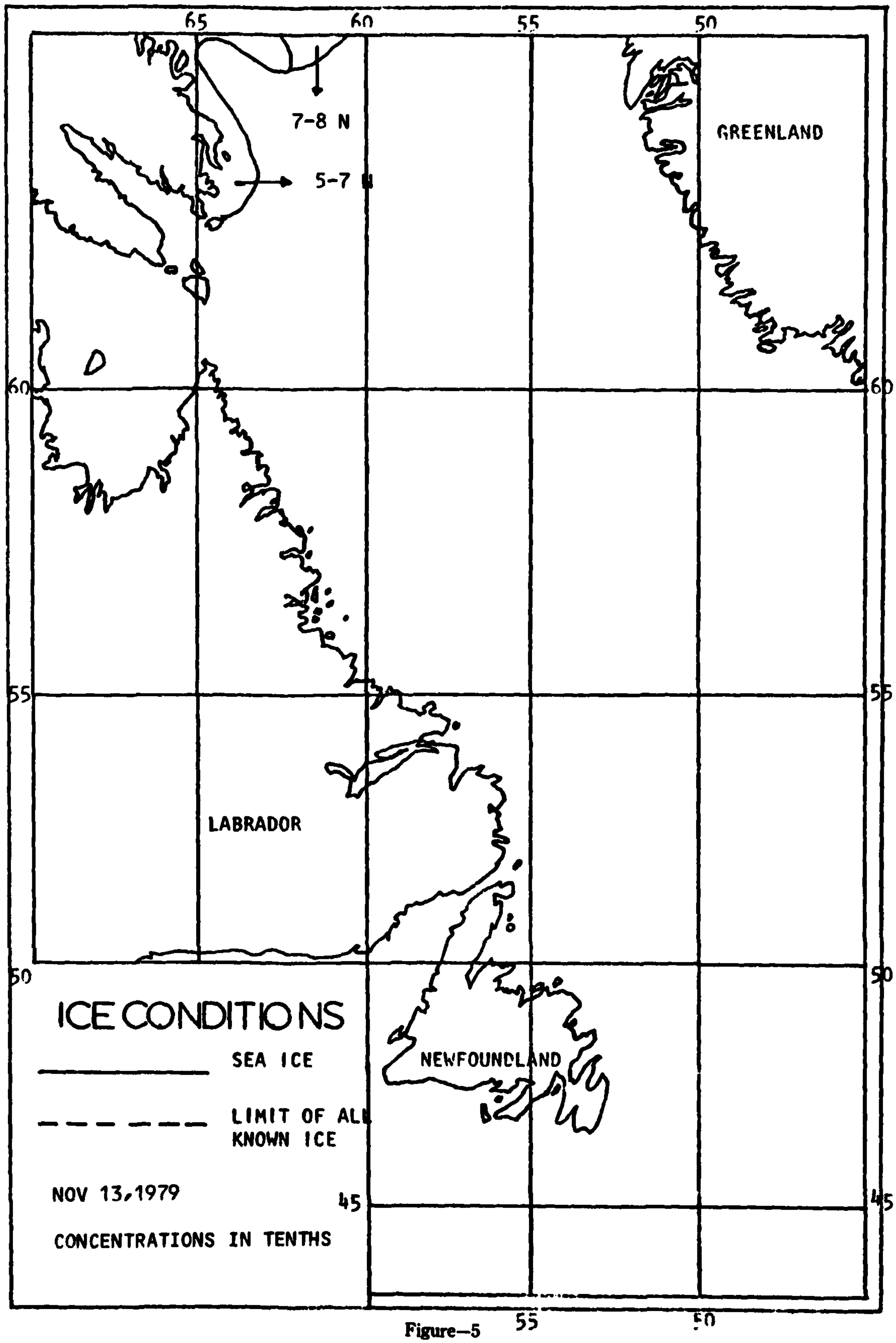
Figure 3.—September 1979–Normal and Monthly Average Surface Pressure in MB



NORMAL (1948-1970) OCT

OCT 1979

Figure 4.—October 1979–Normal and Monthly Average Surface Pressure in MB


65
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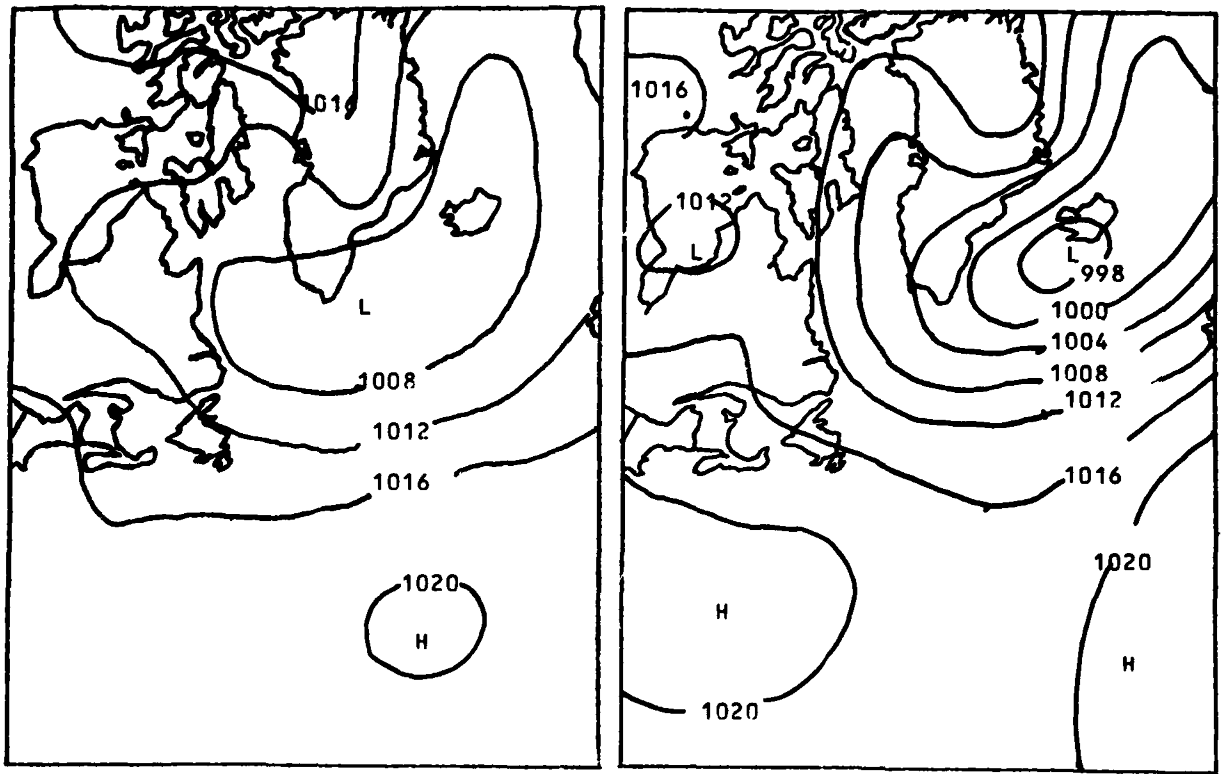
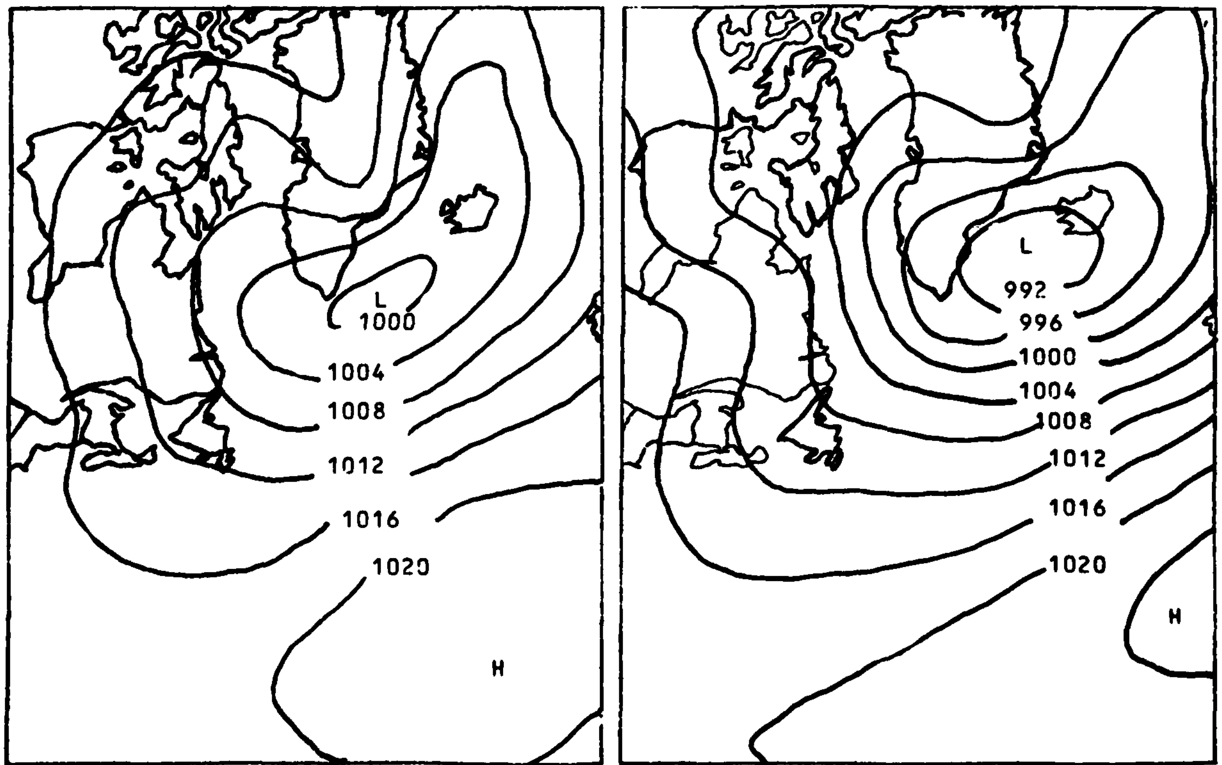
7-8 N
5-7 N
GREENLAND
60
60
55
55
LABRADOR
50
50
ICE CONDITIONS
SEA ICE
LIMIT OF ALL KNOWN ICE
NEWFOUNDLAND
NOV 13,1979
45
45
CONCENTRATIONS IN TENTHS
55
50

Figure—5



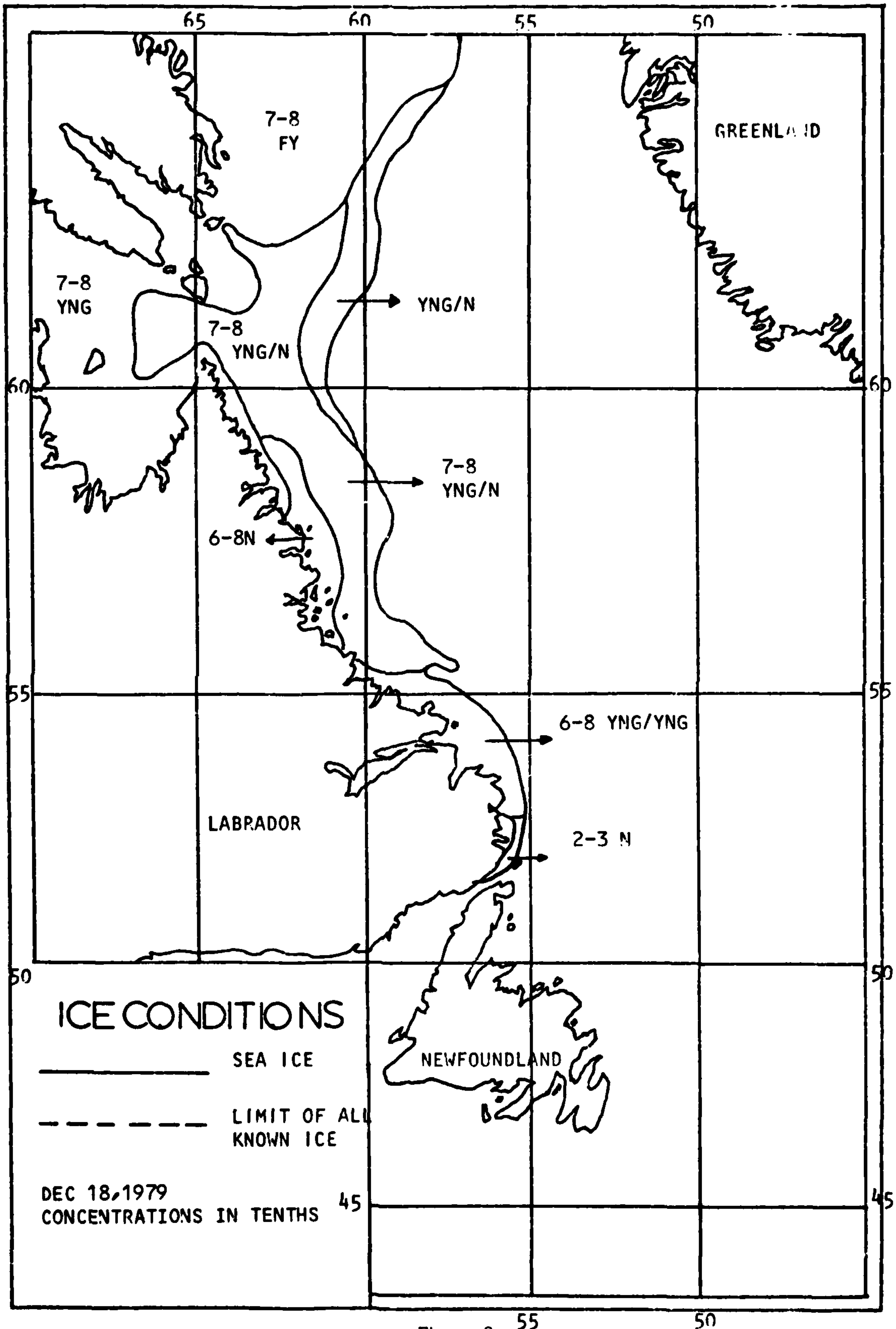
NORMAL(1948-1970) NOV NOV 1979

Figure 6.—November 1979–Normal and Monthly Average Surface Pressure in MB



NORMAL (1948-1970) DEC DEC 1979

Figure 7.—December 1979–Normal and Monthly Average Surface Pressure in MB


65
60
55
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7-8
FY
GREENLAND
7-8
YNG
7-8
YNG/N
YNG/N
60
7-8
YNG/N
6-8N
55
6-8 YNG/YNG
LABRADOR
2-3 N
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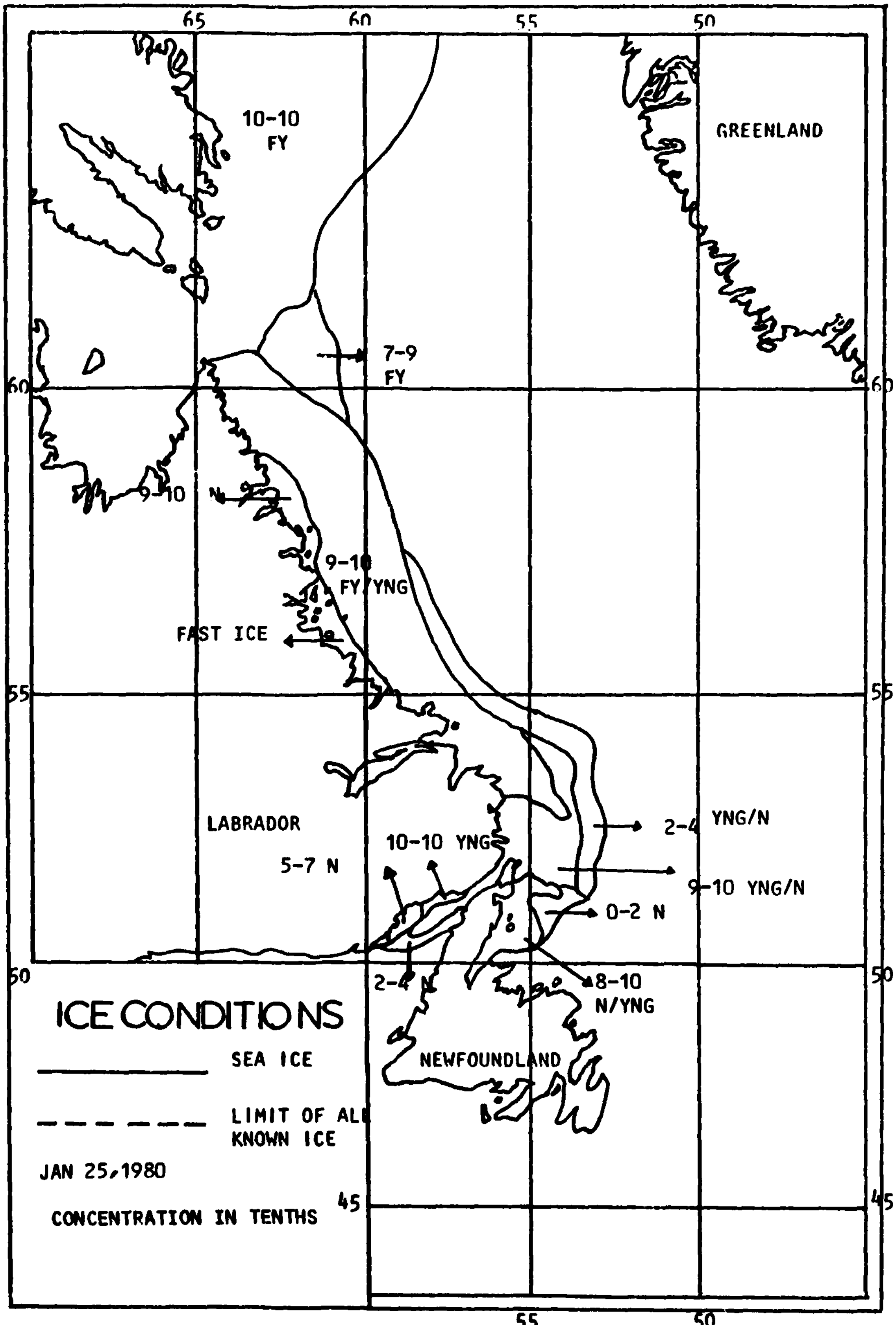
ICE CONDITIONS
SEA ICE
LIMIT OF ALL KNOWN ICE
NEWFOUNDLAND
DEC 18, 1979
CONCENTRATIONS IN TENTHS
45
55
50

Figure—8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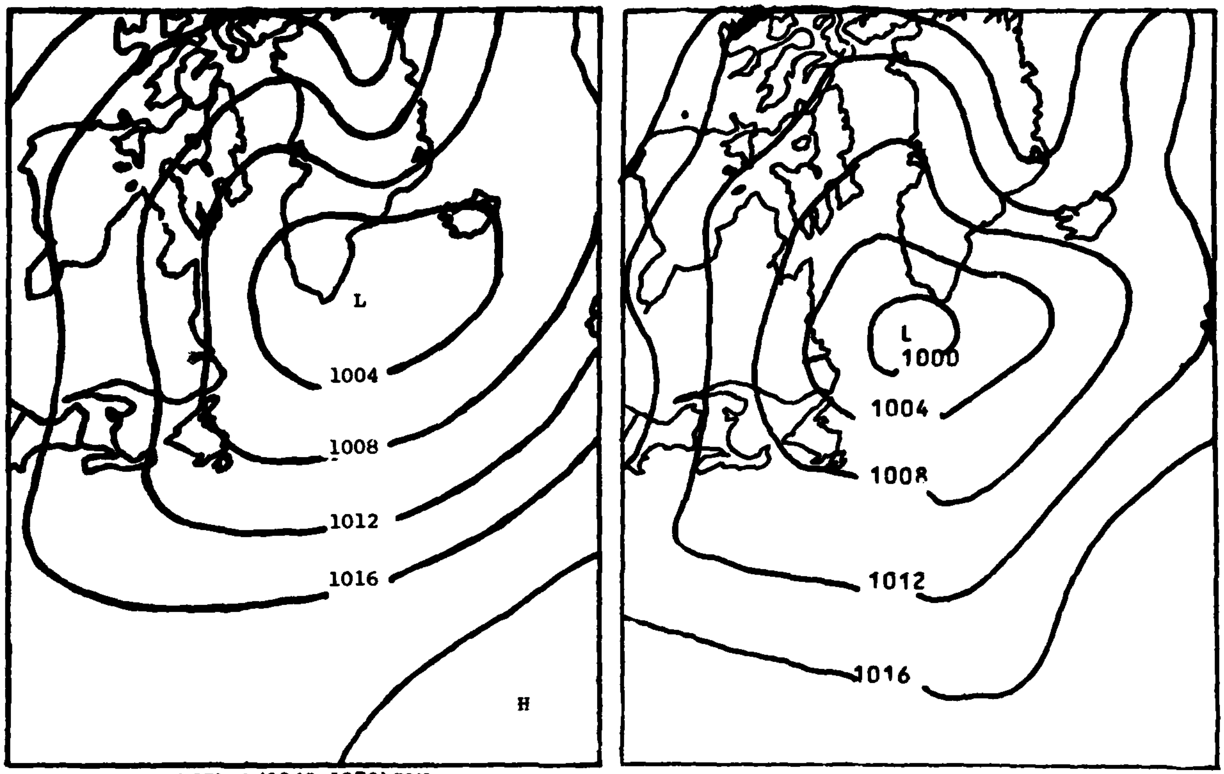
50
GREENLAND
10-10
FY
7-9
FY
9-10 N
9-10
FY/YNG
FAST ICE
LABRADOR
10-10 YNG
5-7 N
2-4 YNG/N
9-10 YNG/N
0-2 N
8-10
N/YNG
2-4 N
NEWFOUNDLAND
ICE CONDITIONS
SEA ICE
LIMIT OF ALL
KNOWN ICE
JAN 25, 1980
CONCENTRATION IN TENTHS
45

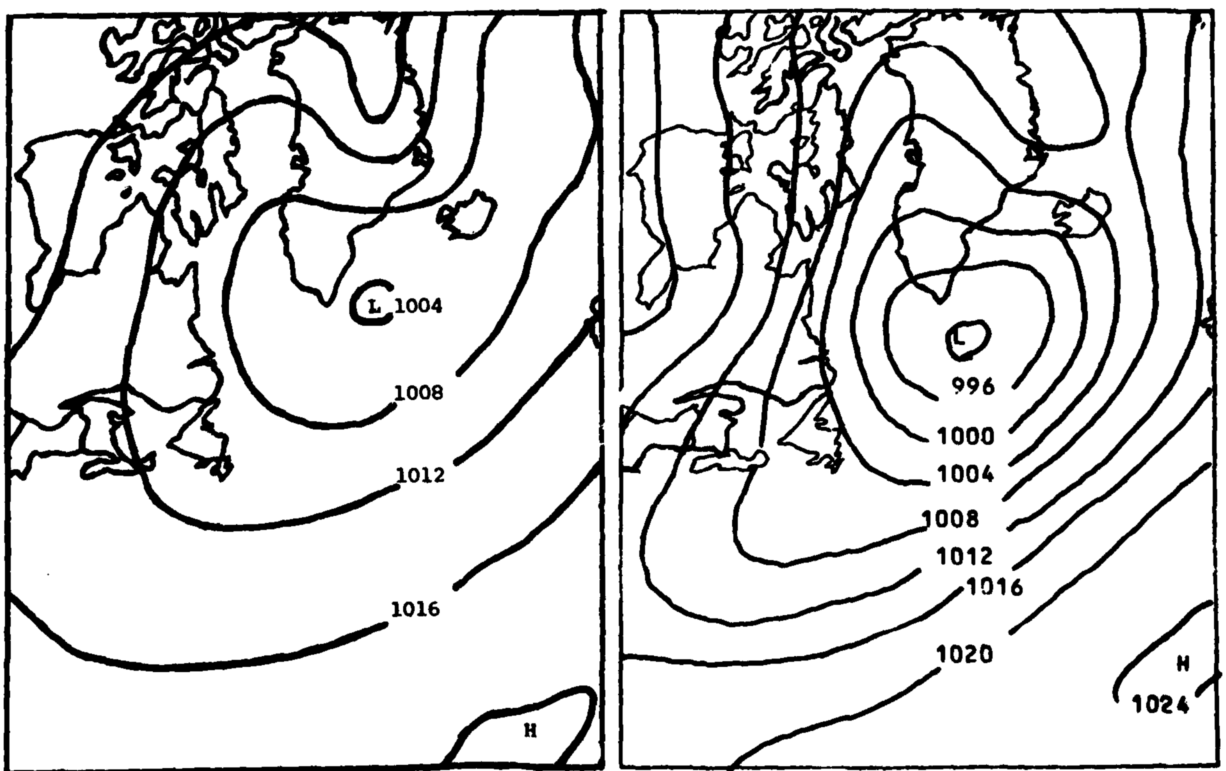
Figure—9



NORMAL (1948-1970) JAN

JAN 1980

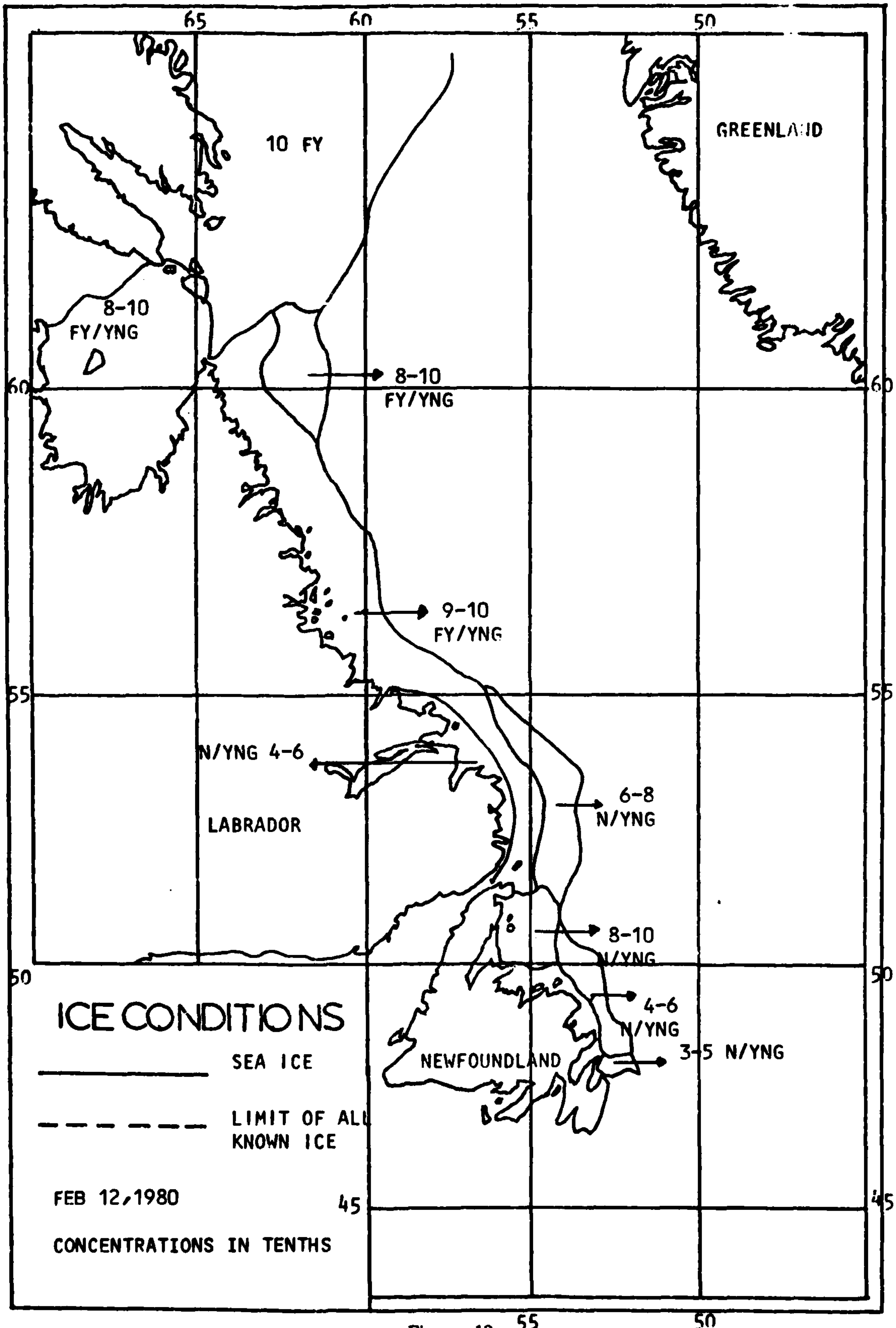
Figure 10.—January 1980-Normal and Monthly Average Surface Pressure in MB



NORMAL (1948-1970) FEB

FEB 1980

Figure 11.—February 1980-Normal and Monthly Average Surface Pressure in MB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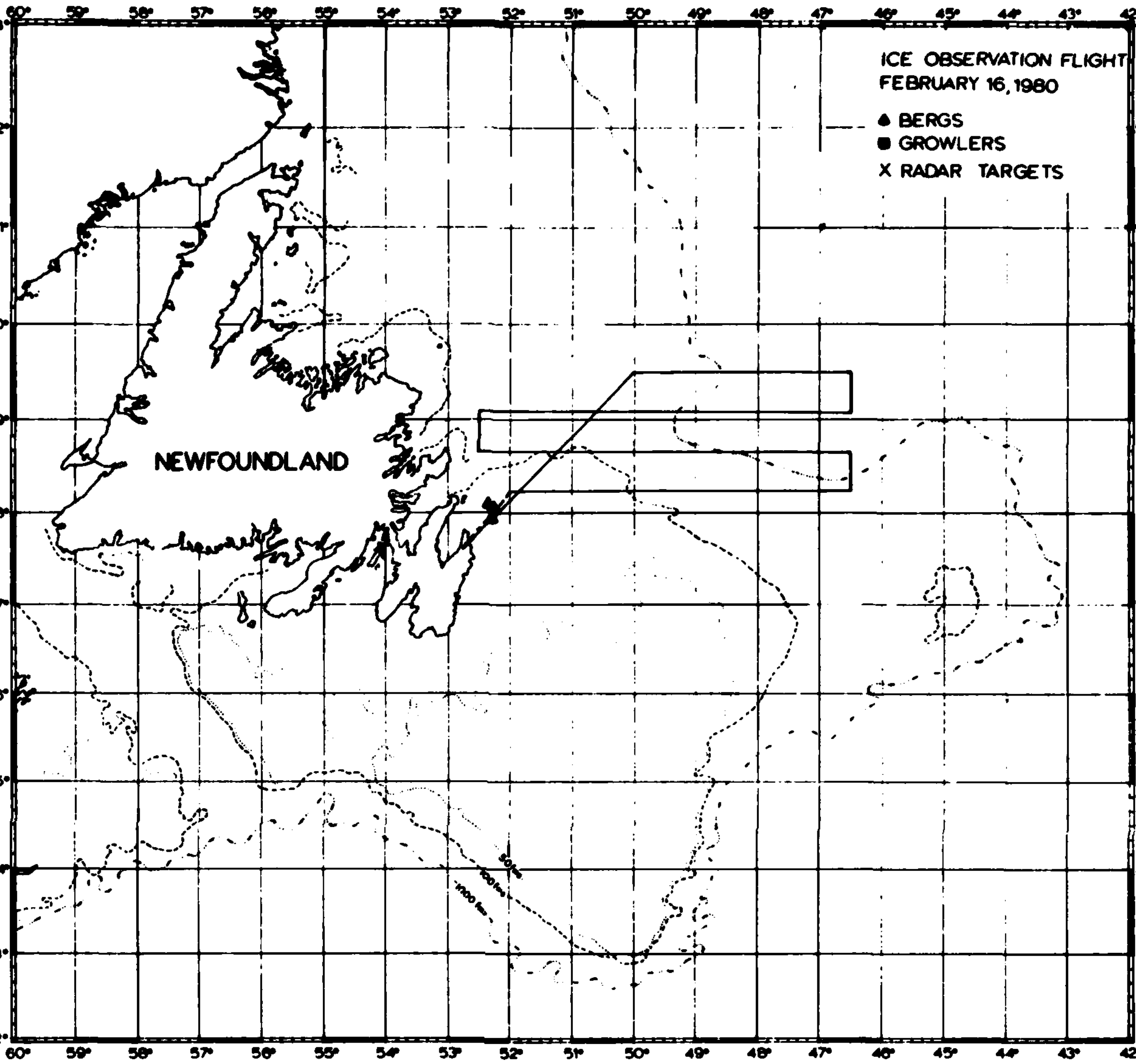
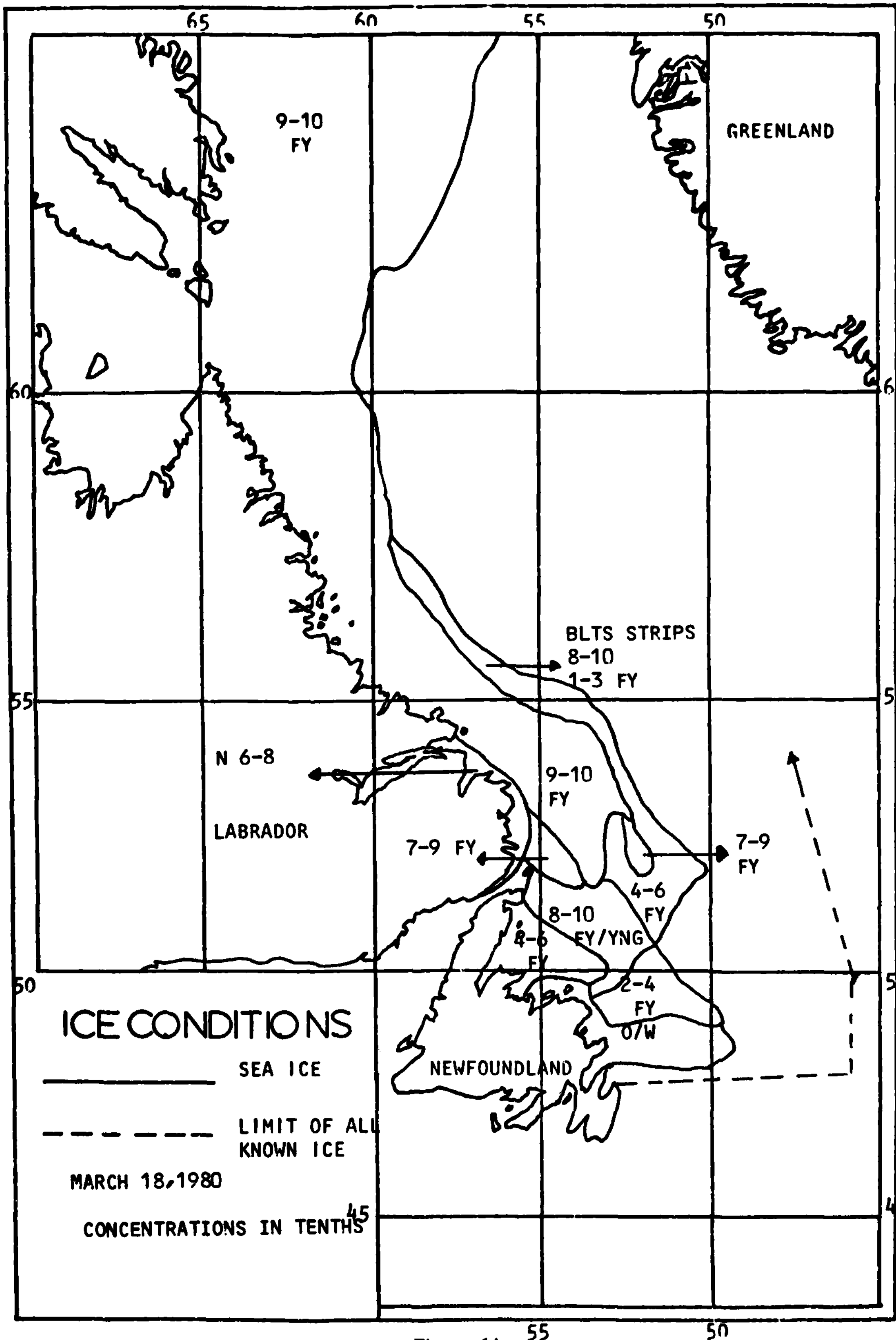
FY/YNG
9-10
FY/YNG
N/YNG 4-6
6-8
N/YNG
LABRADOR
8-10
N/YNG
4-6
N/YNG
3-5 N/YNG
NEWFOUNDLAND
ICE CONDITIONS
SEA ICE
LIMIT OF ALL
KNOWN ICE
FEB 12/1980
CONCENTRATIONS IN TENTHS
45

Figure—12



ICE OBSERVATION FLIGHT
FEBRUARY 16, 1980
BERGS
GROWLERS
X RADAR TARGETS
NEWFOUNDLAND
60° 59° 58° 57° 56° 55° 54° 53° 52° 51° 50° 49° 48° 47° 46° 45° 44° 43° 42°
53° 52° 51° 50° 49° 48° 47° 46° 45° 44° 43° 42°

Figure—13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55
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9-10
FY
GREENLAND
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BLTS STRIPS
8-10
1-3 FY
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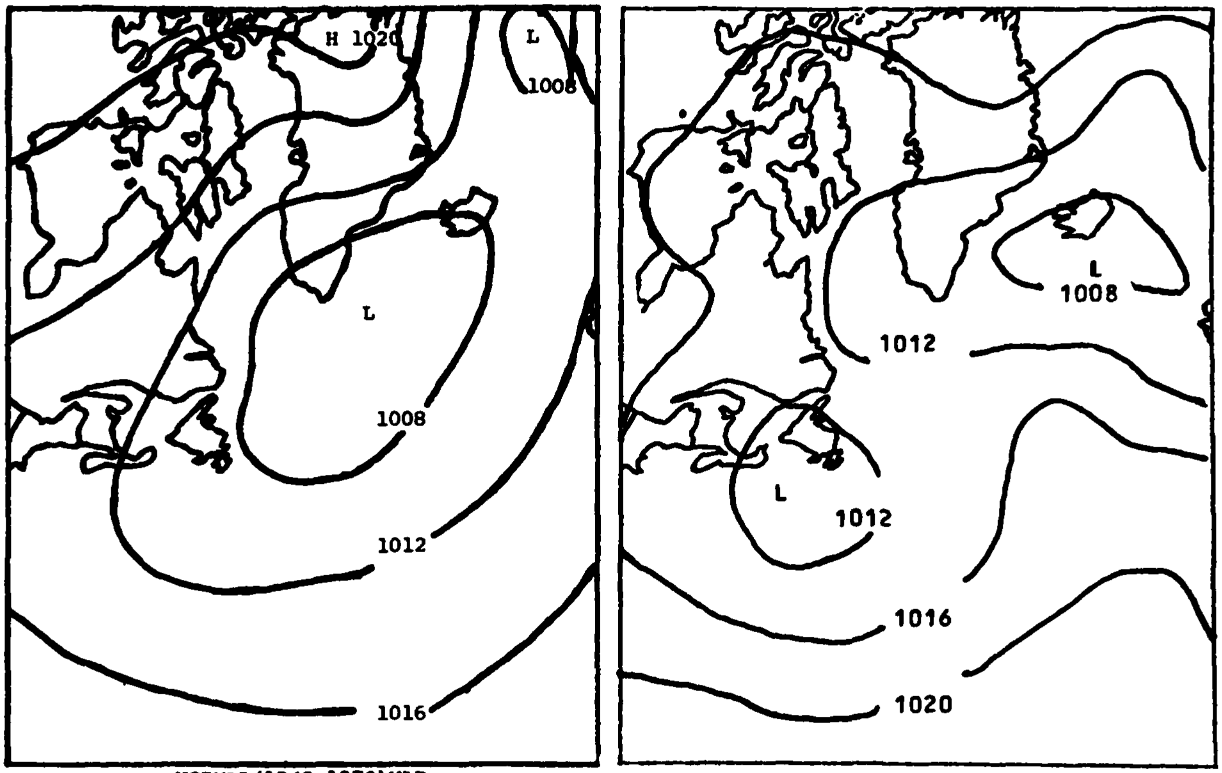
N 6-8
9-10
FY
LABRADOR
7-9 FY
7-9
FY
4-6
FY
8-10
FY/YNG
4-6
FY
50
50
2-4
FY
O/W
ICE CONDITIONS
SEA ICE
NEWFOUNDLAND
LIMIT OF ALL
KNOWN ICE
MARCH 18,1980
45
45
CONCENTRATIONS IN TENTHS
55
50

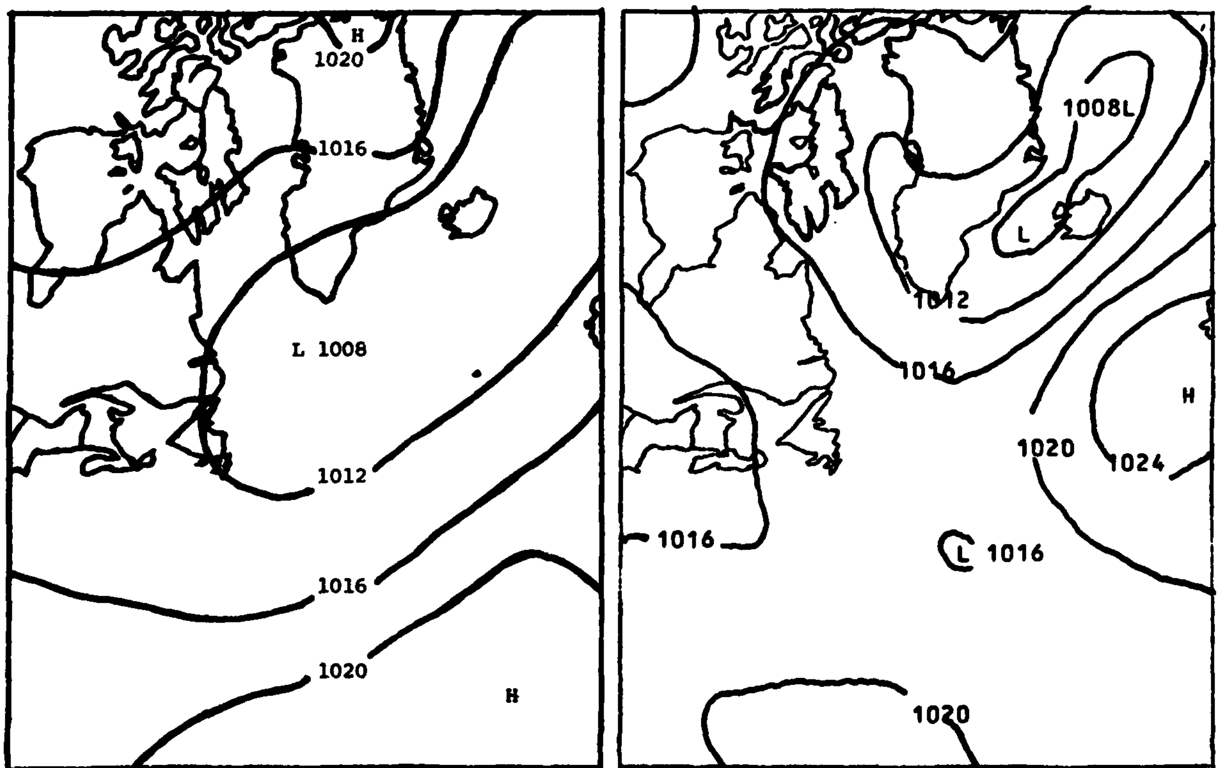
Figure—14



NORMAL (1948-1970) MAR

MAR 1980

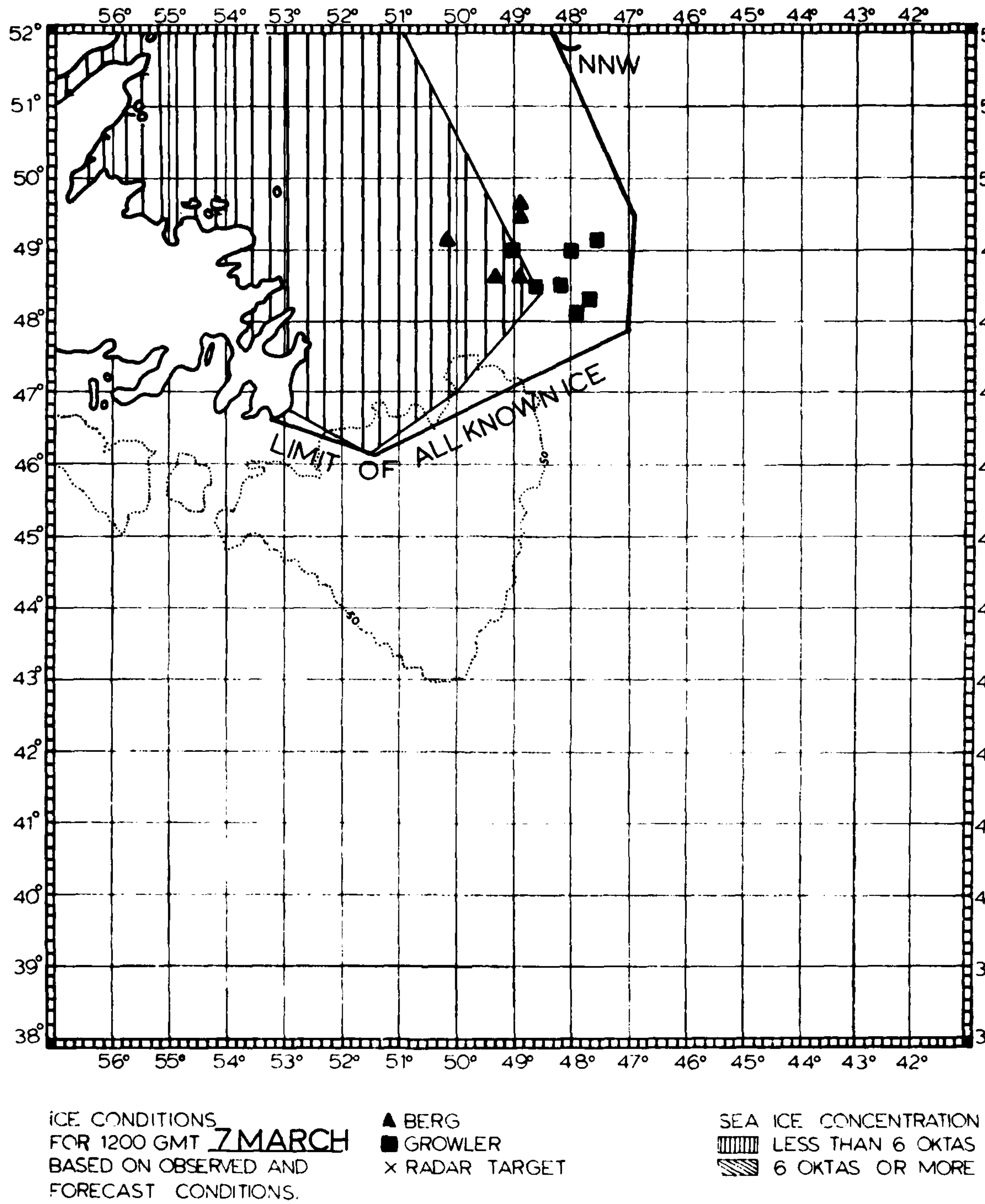
Figure 15.—March 1980–Normal and Monthly Average Surface Pressure in MB



NORMAL (1948-1970) APR

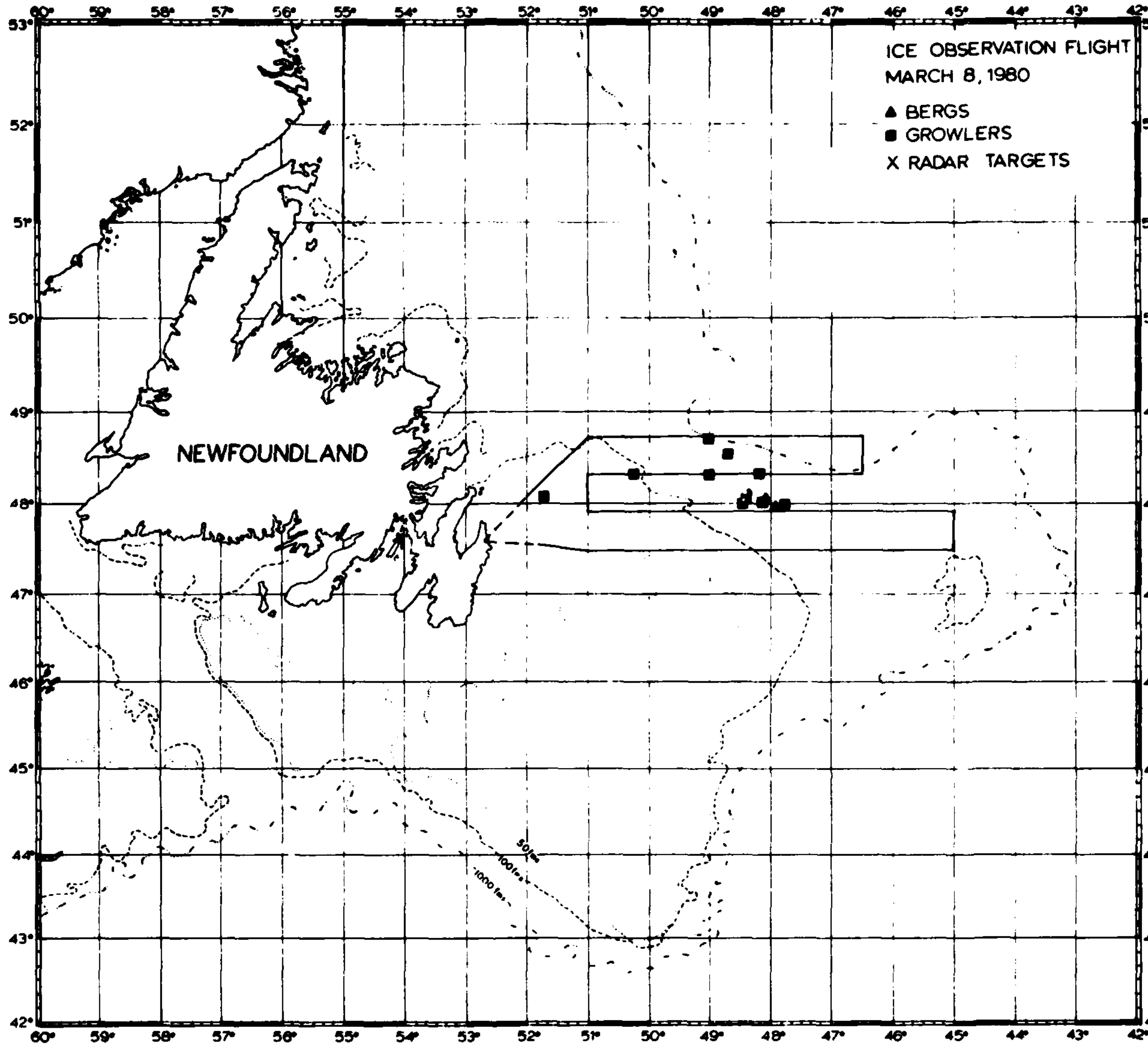
APRIL 1980

Figure 16.—April 1980–Normal and Monthly Average Surface Pressure in MB

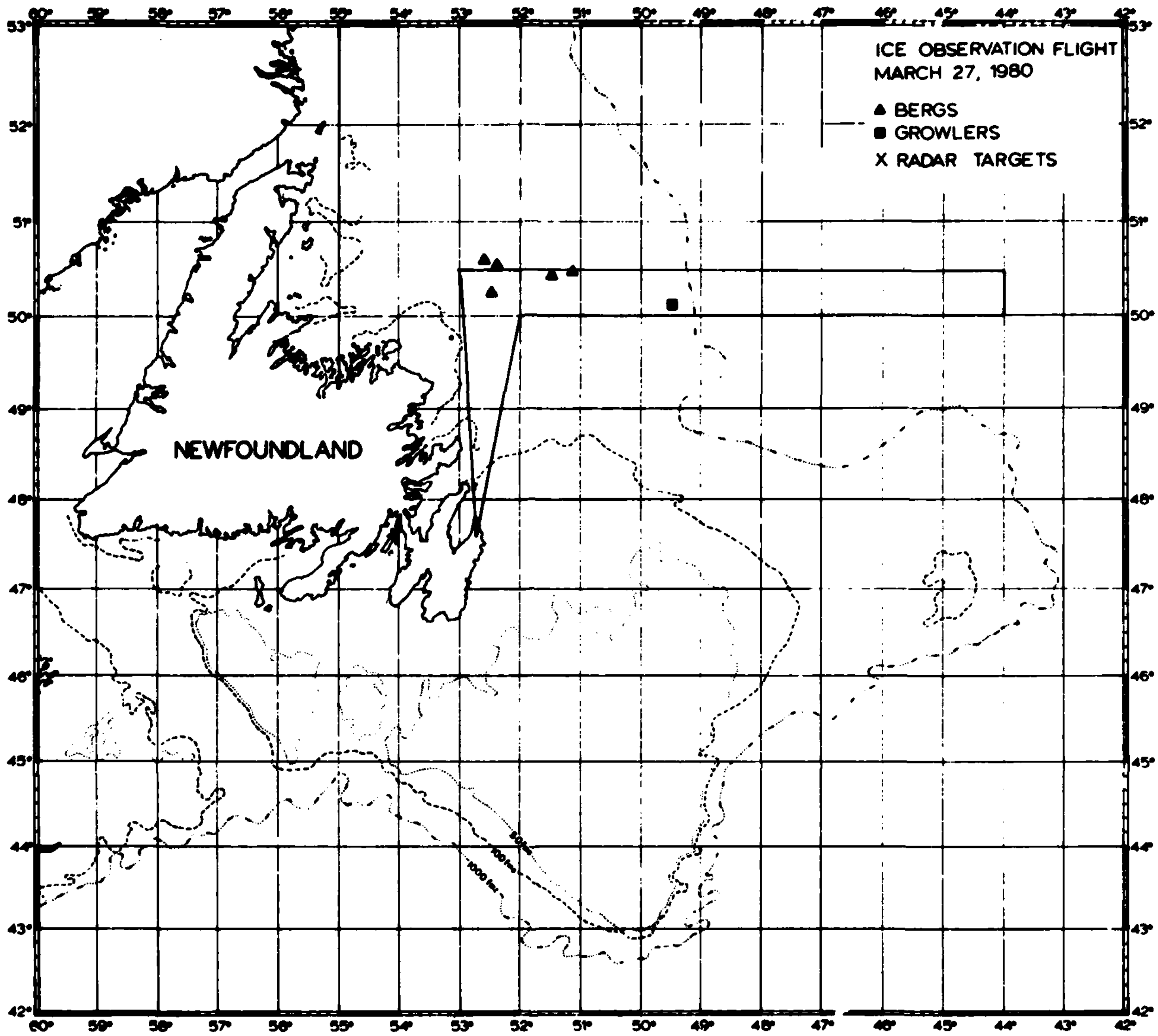


NNW
LIMIT OF ALL KNOWN ICE
ICE CONDITIONS
FOR 1200 GMT 7 MARCH
BASED ON OBSERVED AND
FORECAST CONDITIONS.
▲ BERG
■ GROWLER
× RADAR TARGET
SEA ICE CONCENTRATION
LESS THAN 6 OKTAS
6 OKTAS OR MORE

Figure—17

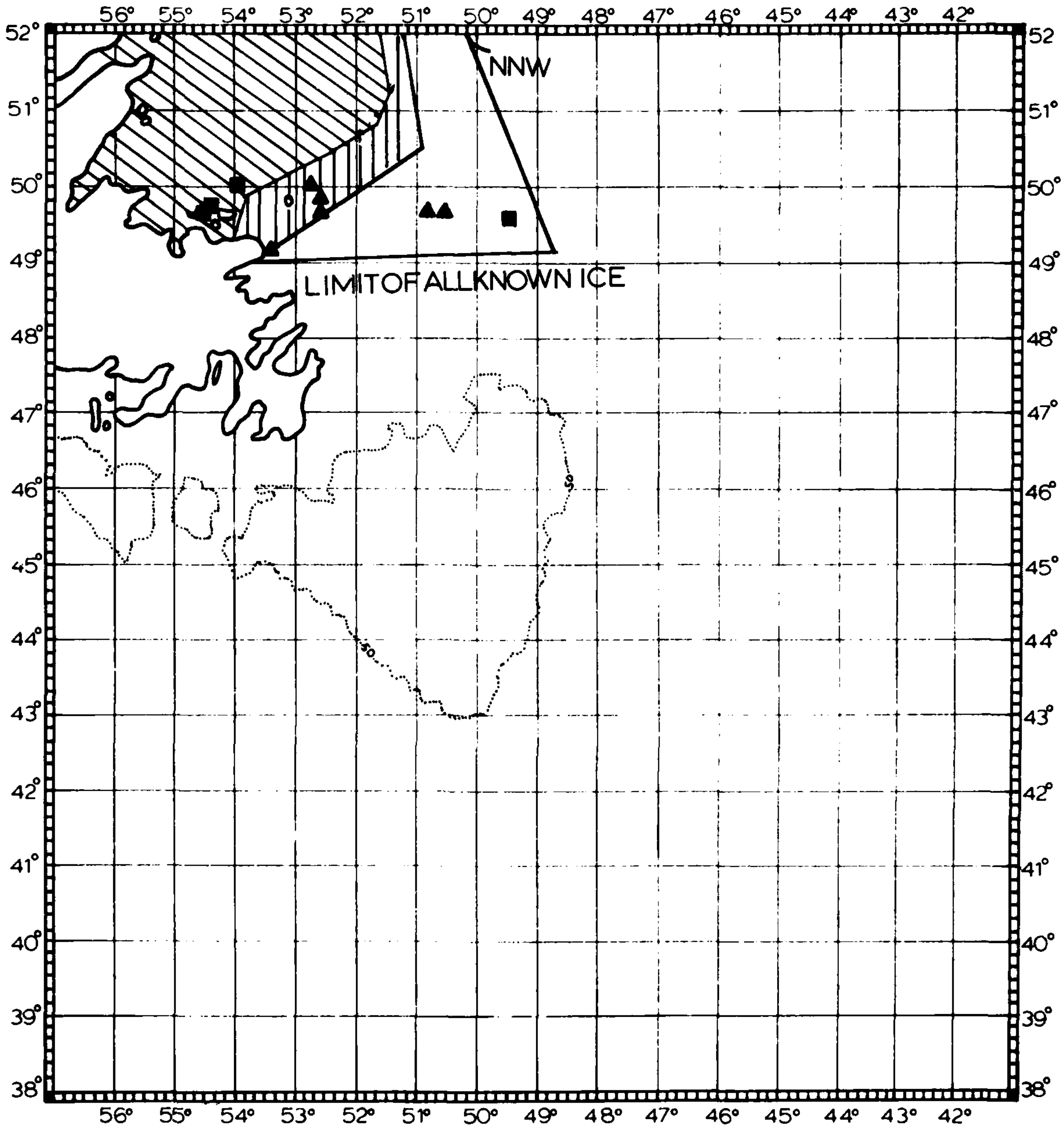

ICE OBSERVATION FLIGHT
MARCH 8, 1980
▲ BERGS
■ GROWLERS
X RADAR TARGETS
NEWFOUNDLAND
60° 59° 58° 57° 56° 55° 54° 53° 52° 51° 50° 49° 48° 47° 46° 45° 44° 43° 42°
53° 52° 51° 50° 49° 48° 47° 46° 45° 44° 43° 42°
50 fm
100 fm
1000 fm

Figure—18



ICE OBSERVATION FLIGHT
MARCH 27, 1980
▲ BERGS
■ GROWLERS
X RADAR TARGETS
NEWFOUNDLAND

Figure—19

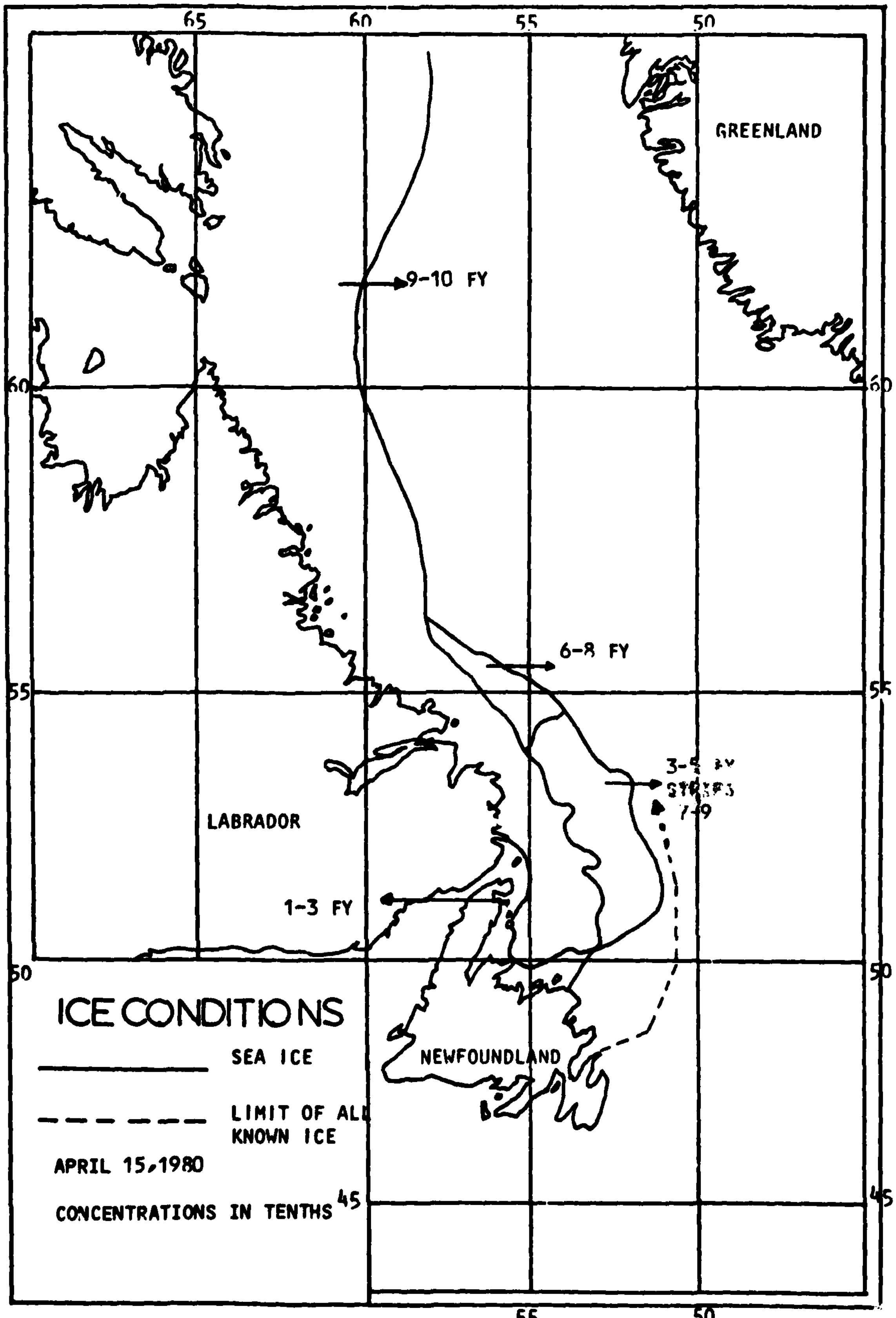


ICE CONDITIONS
FOR 1200 GMT 31 MARCH
BASED ON OBSERVED AND
FORECAST CONDITIONS.

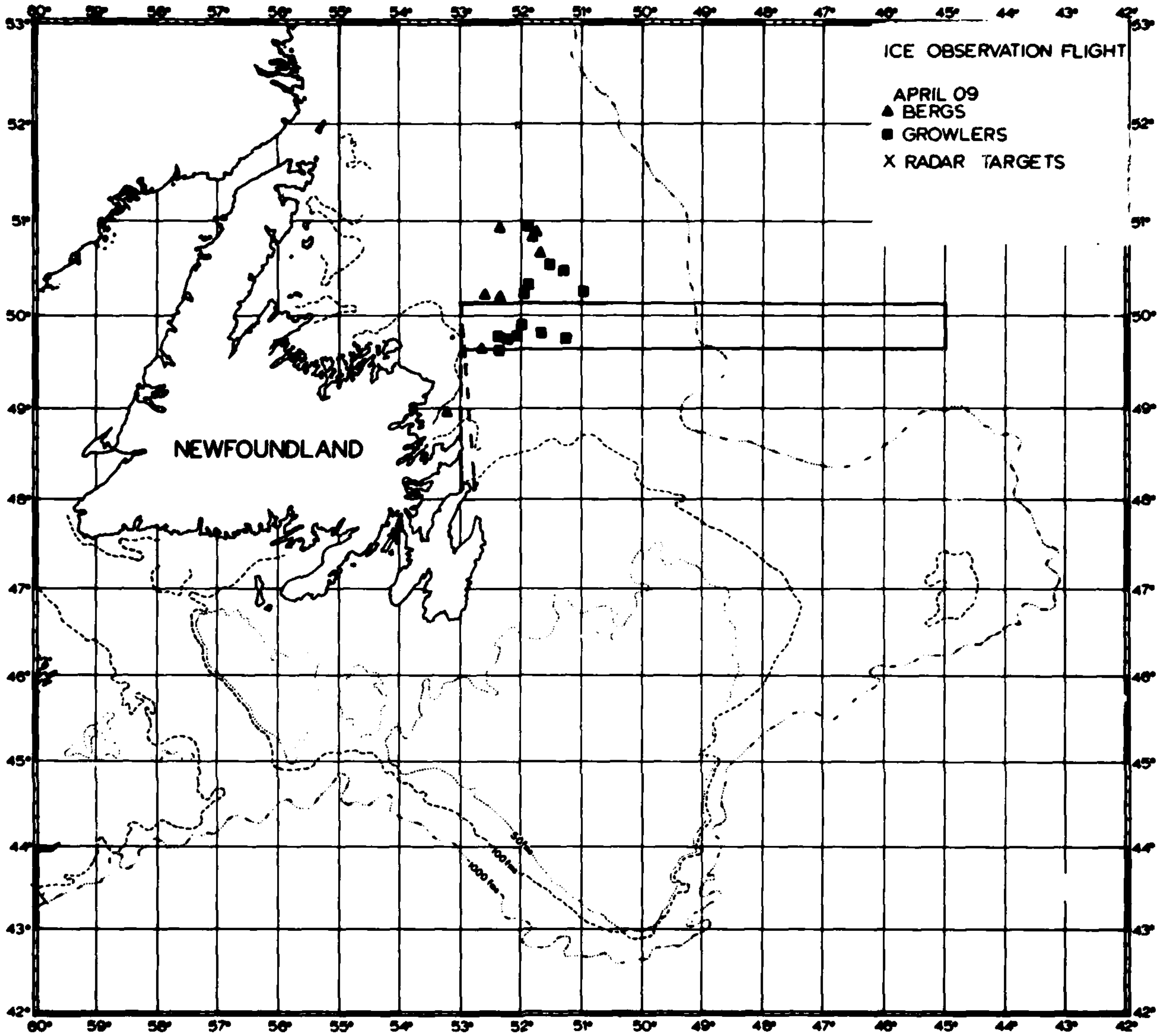
▲ BERG
■ GROWLER
× RADAR TARGET

SEA ICE CONCENTRATION
LESS THAN 6 OKTAS
6 OKTAS OR MORE

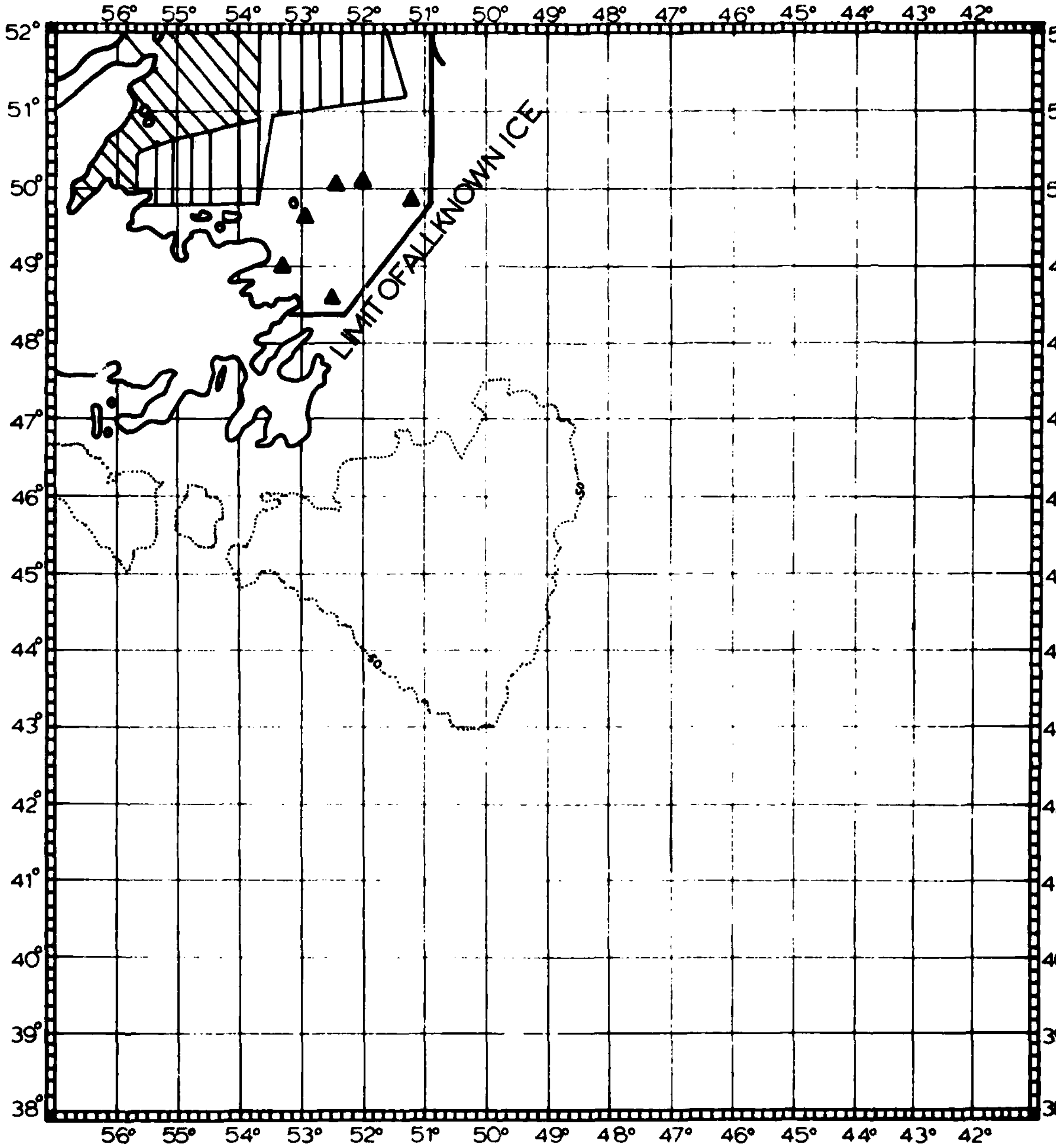
Figure—20


GREENLAND
9-10 FY
6-8 FY
LABRADOR
1-3 FY
NEWFOUNDLAND
ICE CONDITIONS
SEA ICE
LIMIT OF ALL KNOWN ICE
APRIL 15, 1980
CONCENTRATIONS IN TENTHS
65
60
55
50
45

Figure—21


ICE OBSERVATION FLIGHT
APRIL 09
▲ BERGS
■ GROWLERS
X RADAR TARGETS
NEWFOUNDLAND

Figure—22

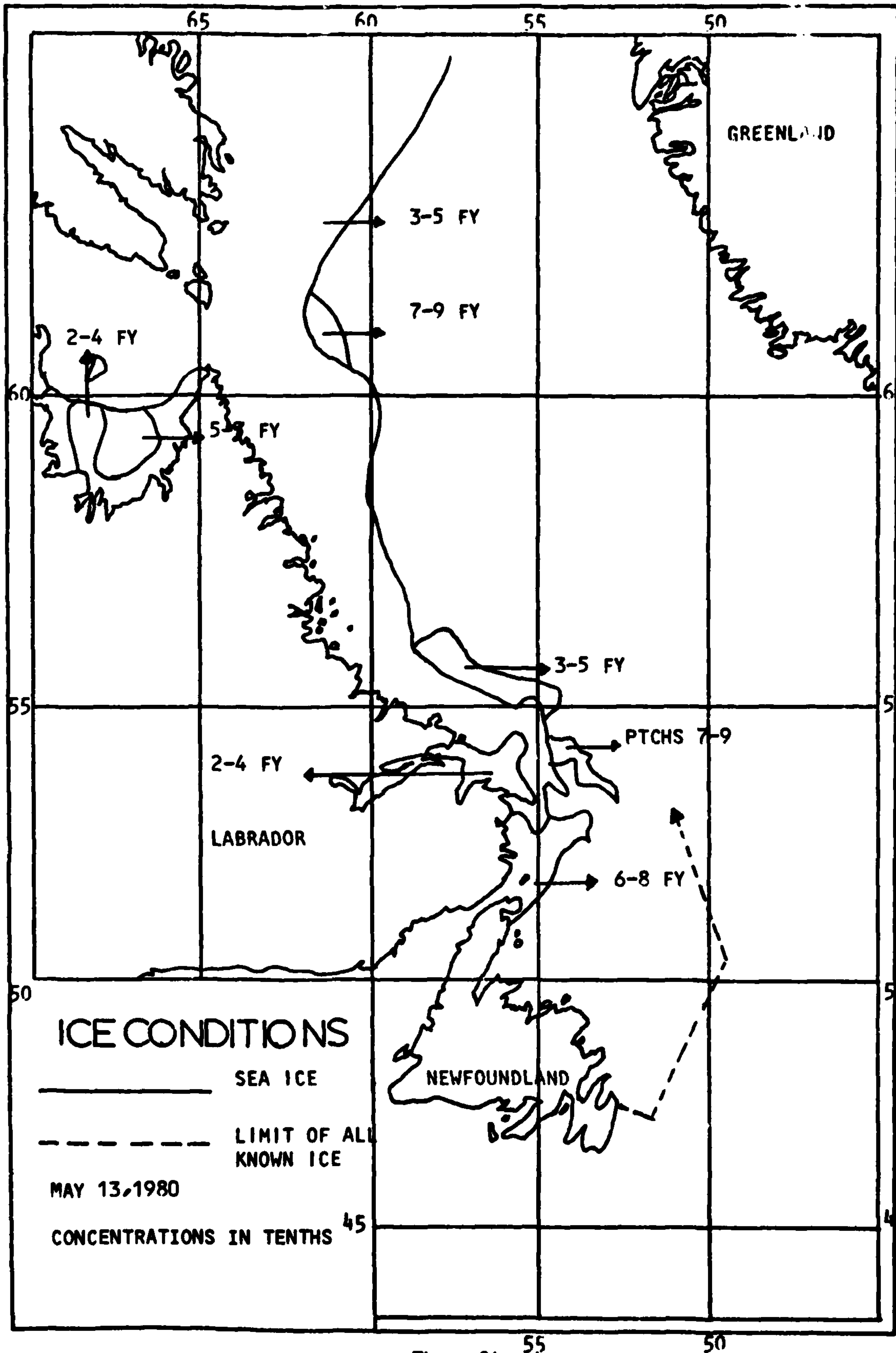


ICE CONDITIONS
FOR 1200 GMT 30 APRIL
BASED ON OBSERVED AND
FORECAST CONDITIONS.

▲ BERG
■ GROWLER
× RADAR TARGET

SEA ICE CONCENTRATION
LESS THAN 6 OKTAS
6 OKTAS OR MORE

Figure—23


65
60
55
50
GREENL ND
3-5 FY
7-9 FY
2-4 FY
60
5-7 FY
60
3-5 FY
55
55
PTCHS 7-9
2-4 FY
LABRADOR
6-8 FY
50
50
ICE CONDITIONS
SEA ICE
NEWFOUNDLAND
LIMIT OF ALL
KNOWN ICE
MAY 13,1980
CONCENTRATIONS IN TENTHS
45
45
55
50

Figure—24

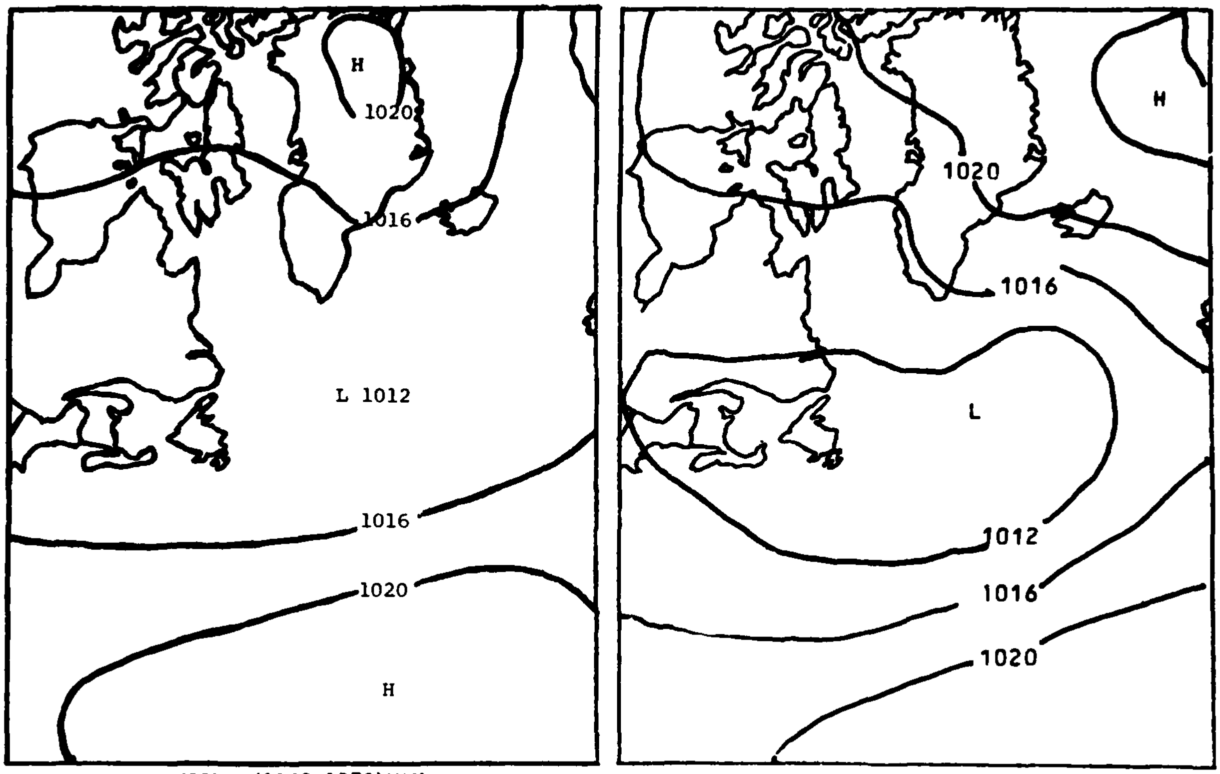


Figure 25.—May 1980-Normal and Monthly Average Surface Pressure in MB

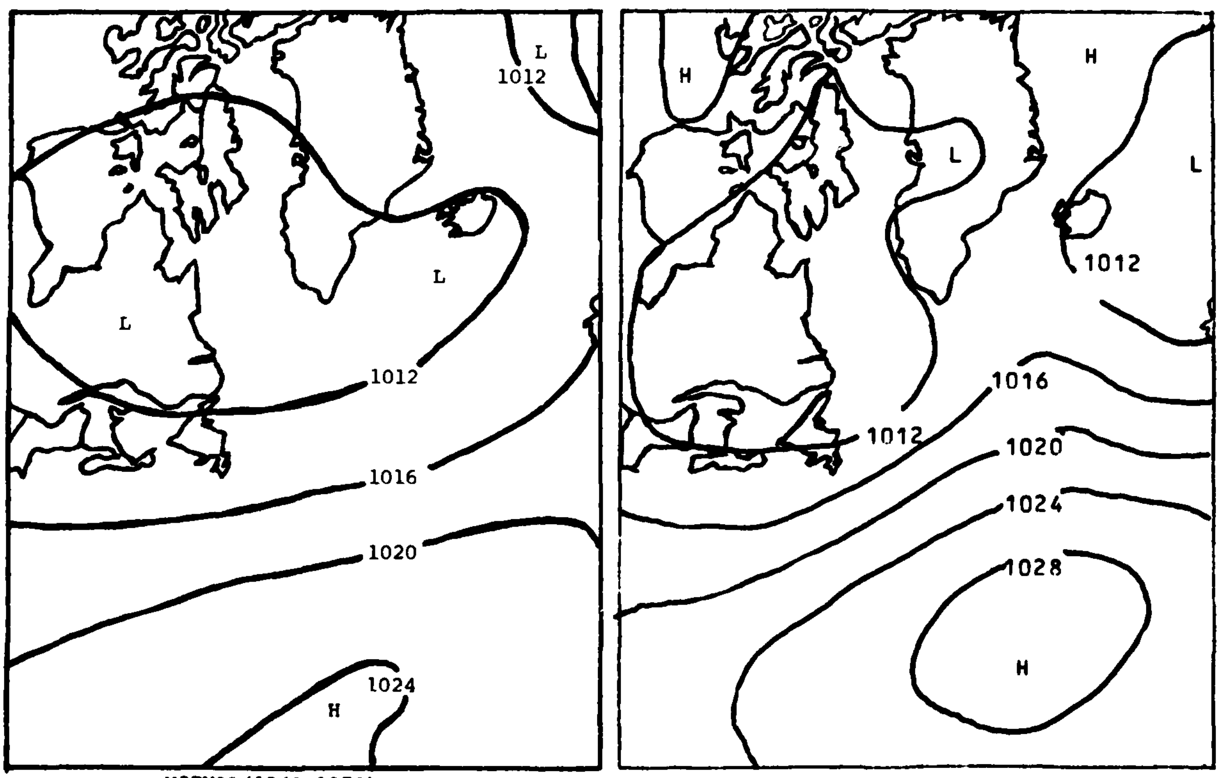
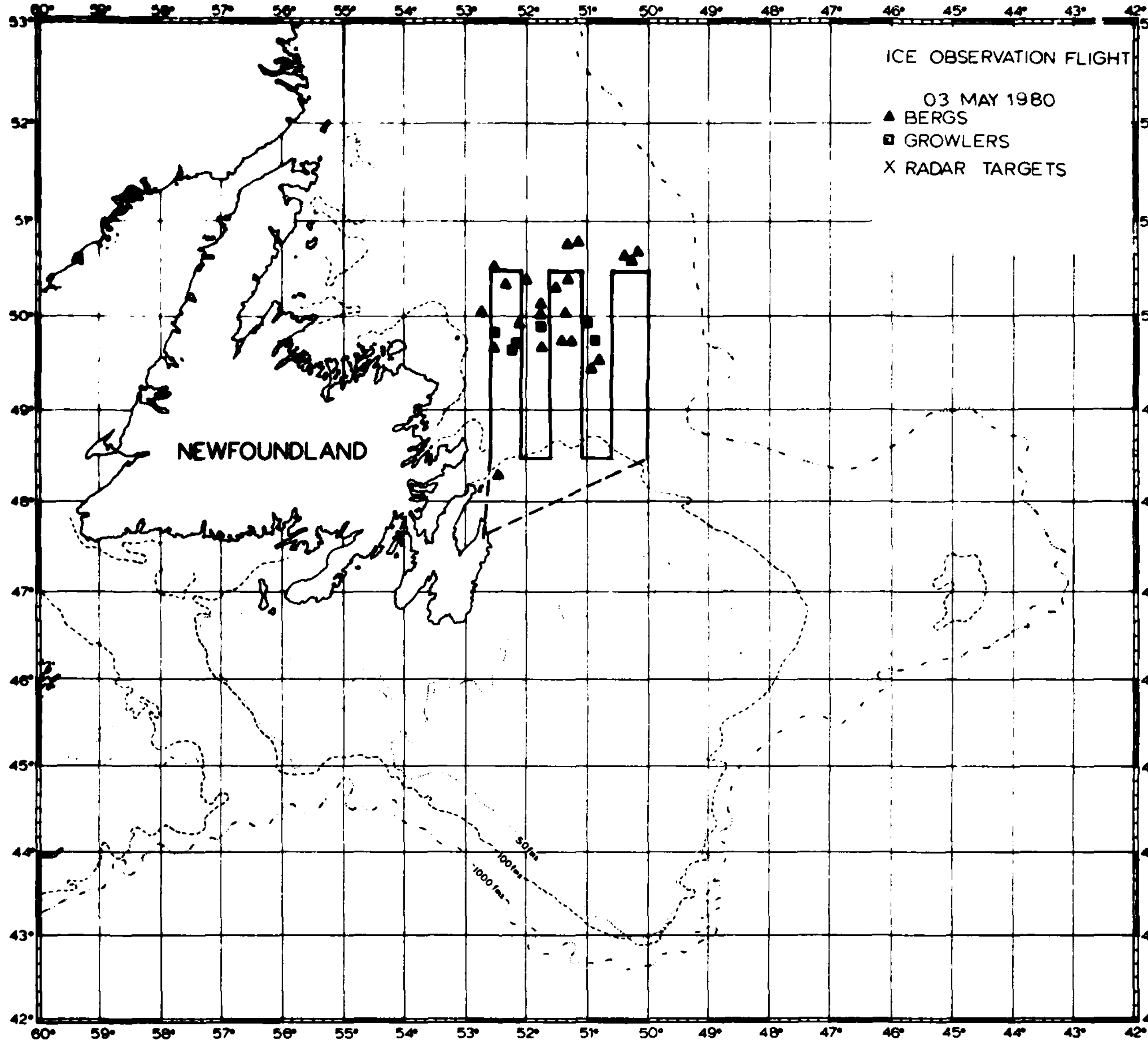
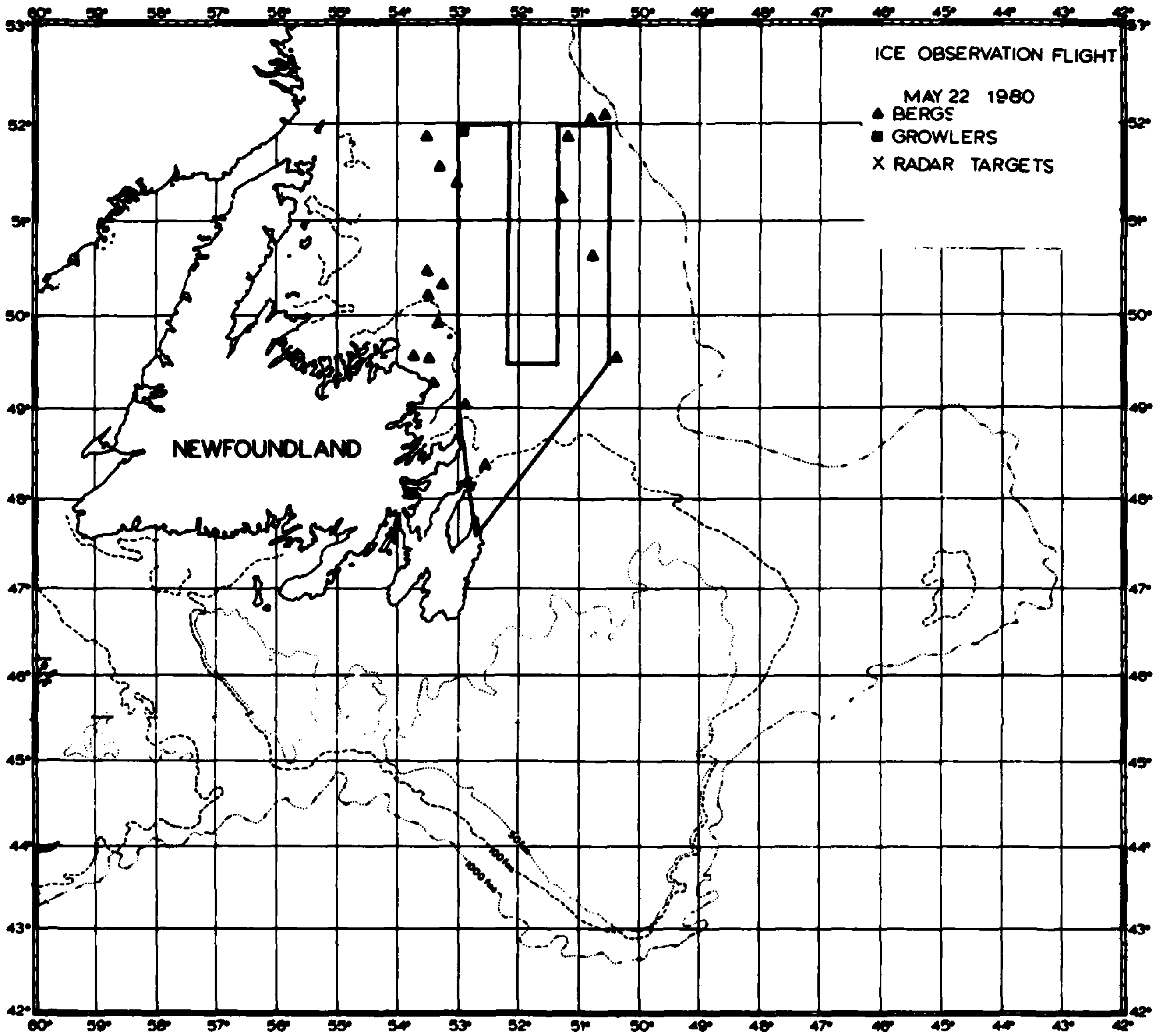


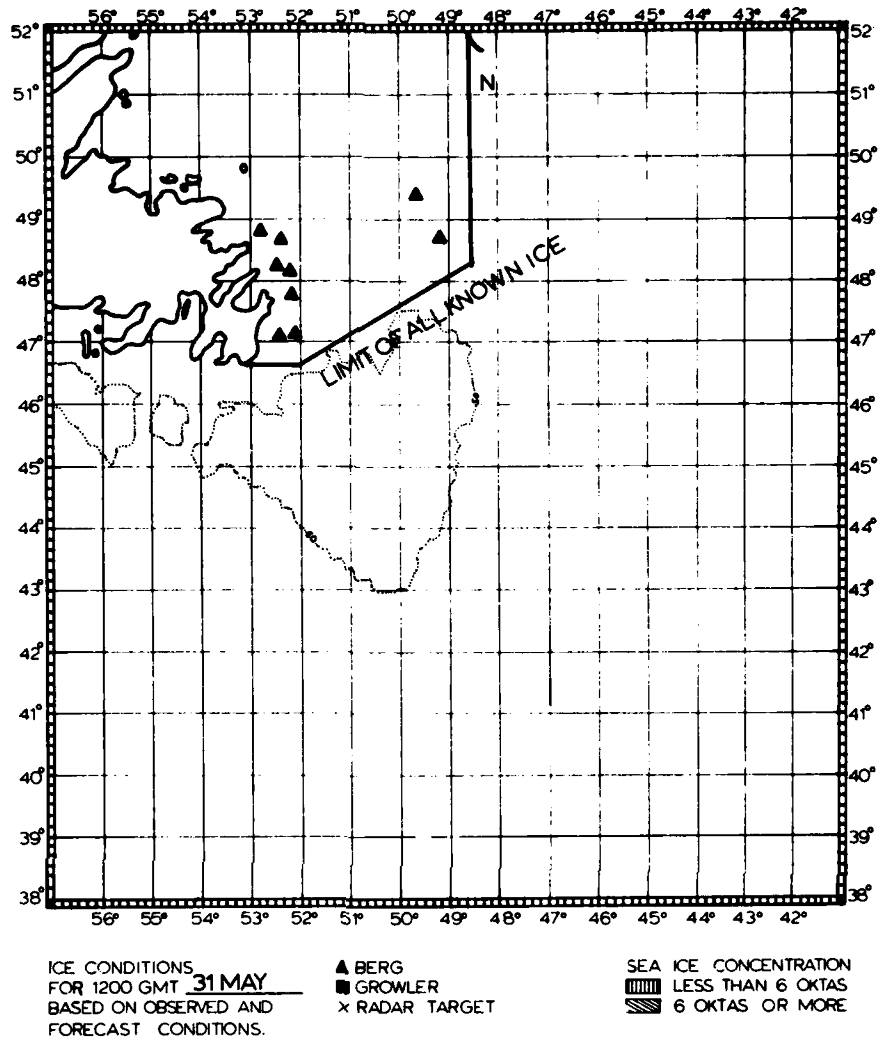
Figure 26.—June 1980-Normal and Monthly Average Surface Pressure in MB


ICE OBSERVATION FLIGHT
03 MAY 1980
▲ BERGS
■ GROWLERS
X RADAR TARGETS
NEWFOUNDLAND
50 fms
100 fms
1000 fms
60° 59° 58° 57° 56° 55° 54° 53° 52° 51° 50° 49° 48° 47° 46° 45° 44° 43° 42°
53° 52° 51° 50° 49° 48° 47° 46° 45° 44° 43° 42°

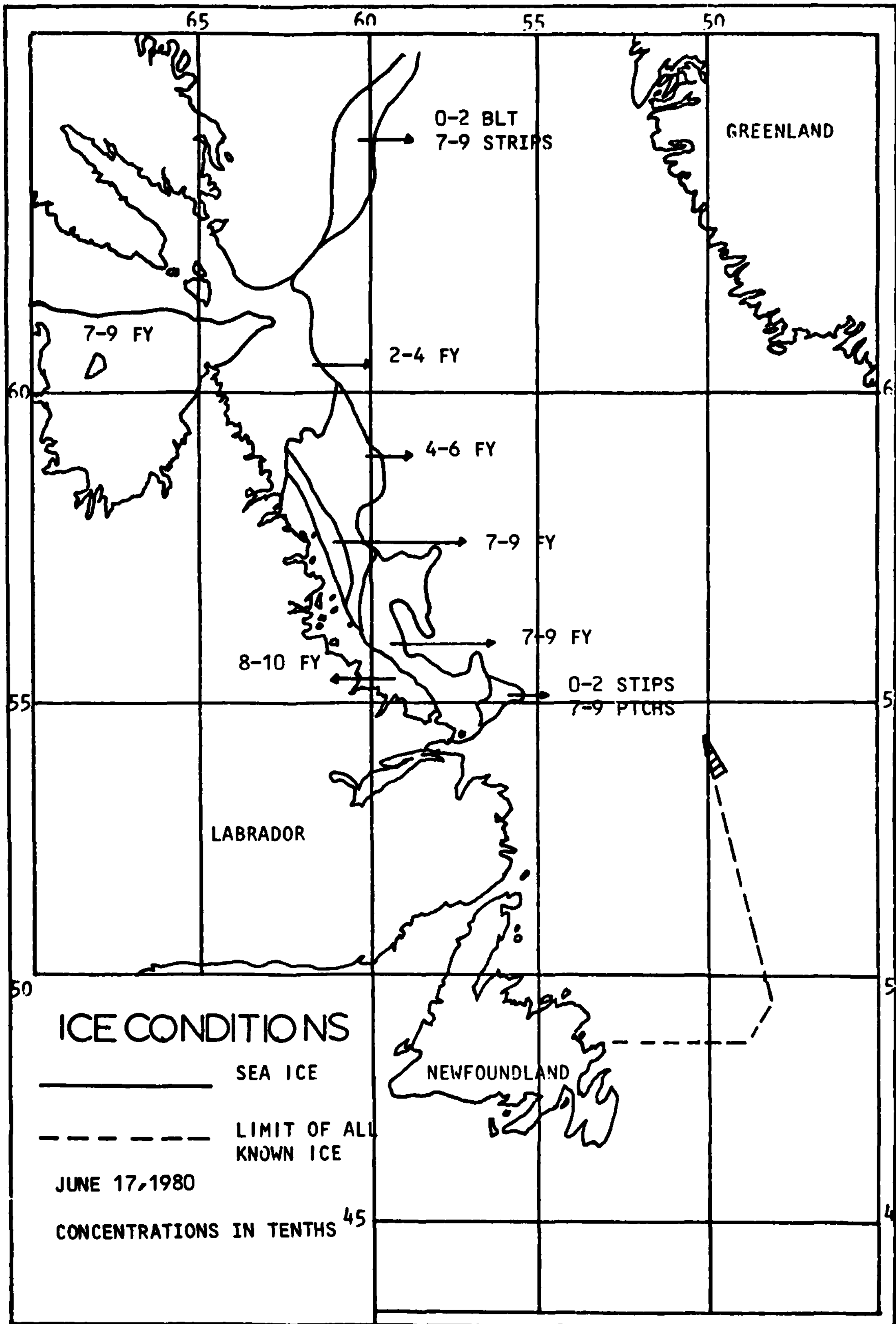
Figure—27


ICE OBSERVATION FLIGHT
MAY 22 1980
▲ BERGS
■ GROWLERS
X RADAR TARGETS
NEWFOUNDLAND

Figure—28

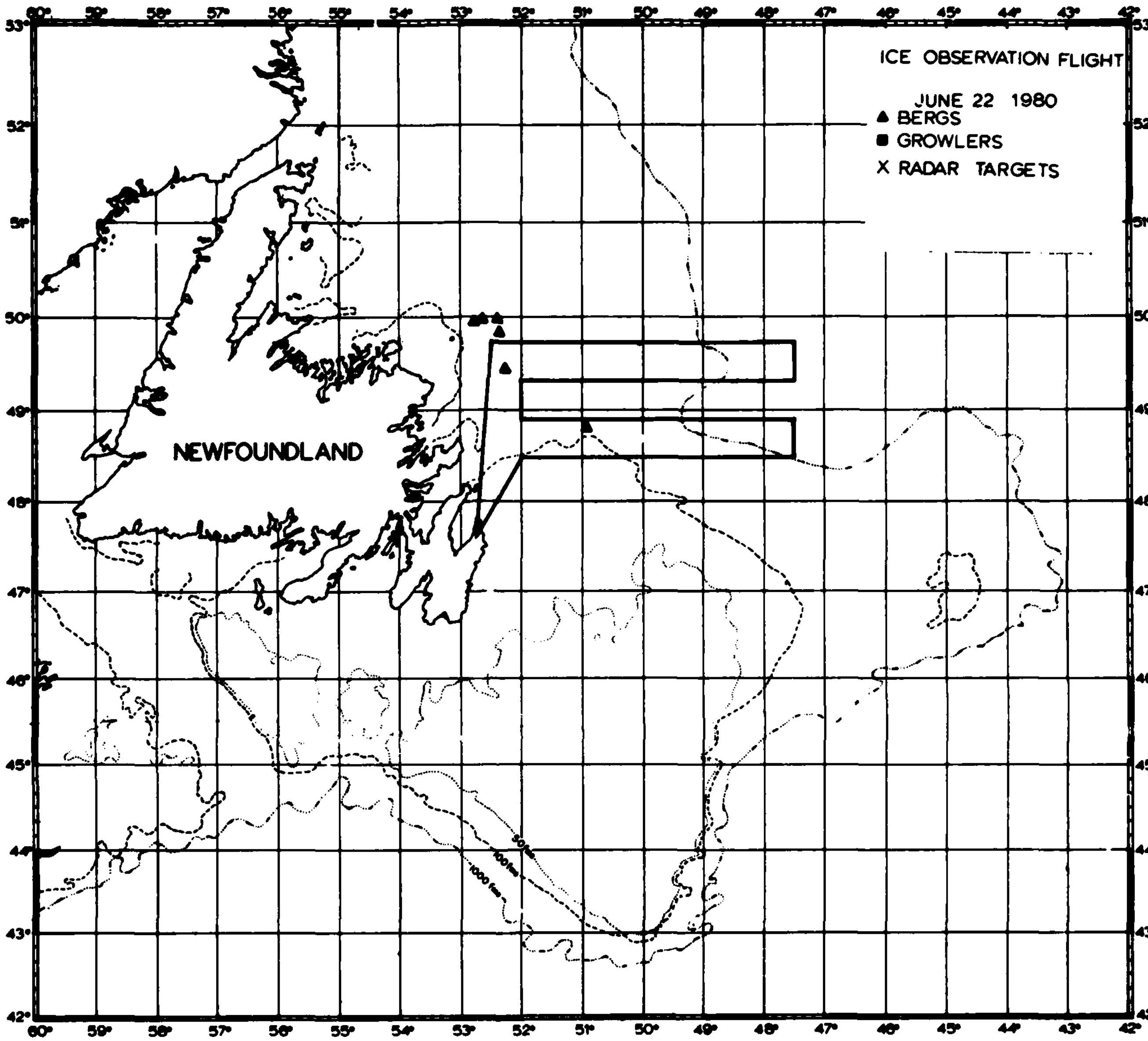

LIMIT OF ALL KNOWN ICE
N
ICE CONDITIONS
FOR 1200 GMT 31 MAY
BASED ON OBSERVED AND
FORECAST CONDITIONS.
▲ BERG
■ GROWLER
× RADAR TARGET
SEA ICE CONCENTRATION
LESS THAN 6 OKTAS
6 OKTAS OR MORE

Figure—29



65
60
55
50
0-2 BLT
7-9 STRIPS
GREENLAND
7-9 FY
2-4 FY
60
4-6 FY
7-9 FY
7-9 FY
8-10 FY
0-2 STIPS
7-9 PTCHS
55
LABRADOR
50
ICE CONDITIONS
SEA ICE
LIMIT OF ALL KNOWN ICE
NEWFOUNDLAND
JUNE 17,1980
CONCENTRATIONS IN TENTHS
45

Figure—30


ICE OBSERVATION FLIGHT
JUNE 22 1980
▲ BERGS
■ GROWLERS
X RADAR TARGETS
NEWFOUNDLAND

Figure—31

INTERNATIONAL ICE PATROL

ISOTHERMS AS OF 24 JUNE 80 (°C)

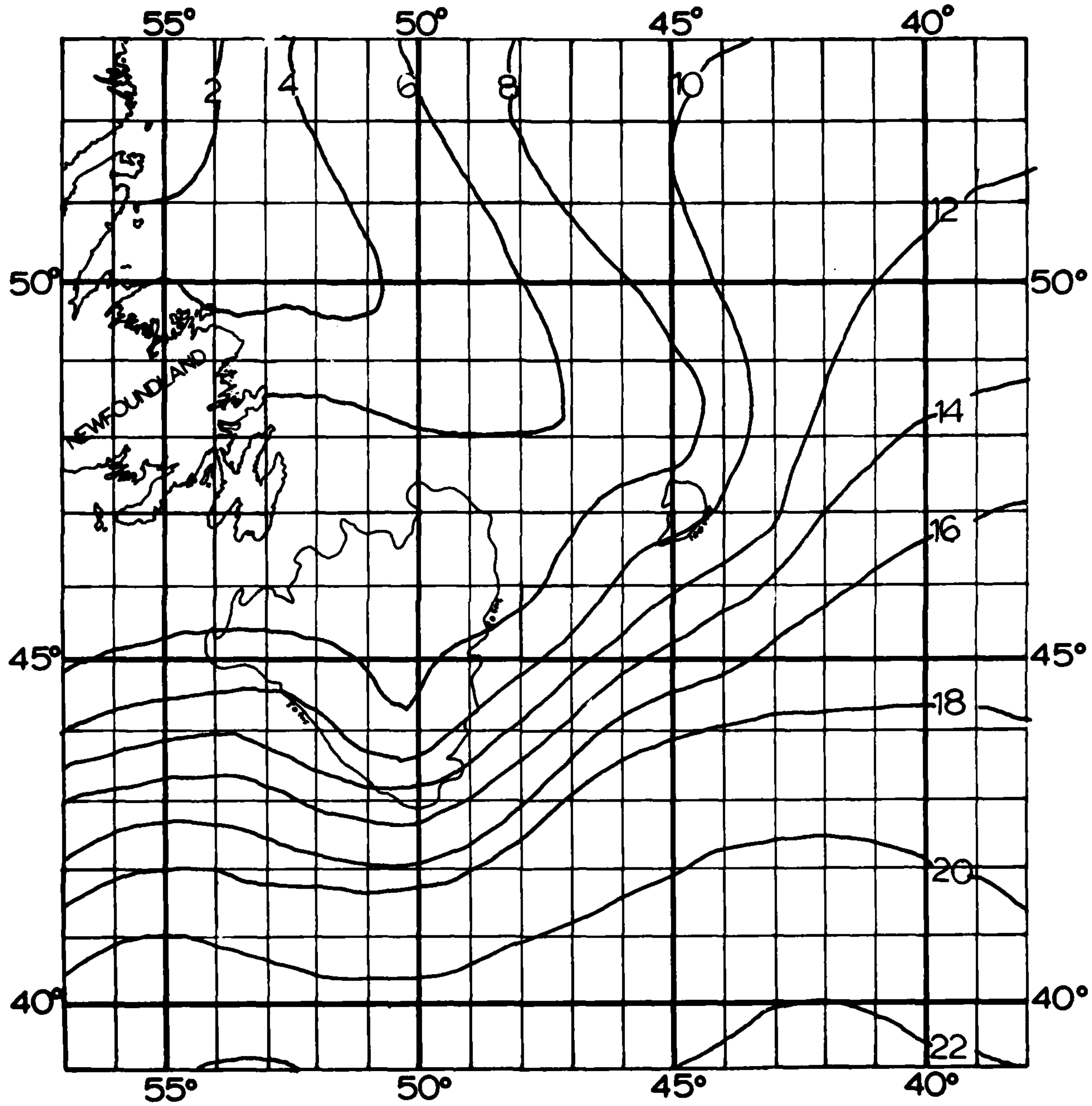
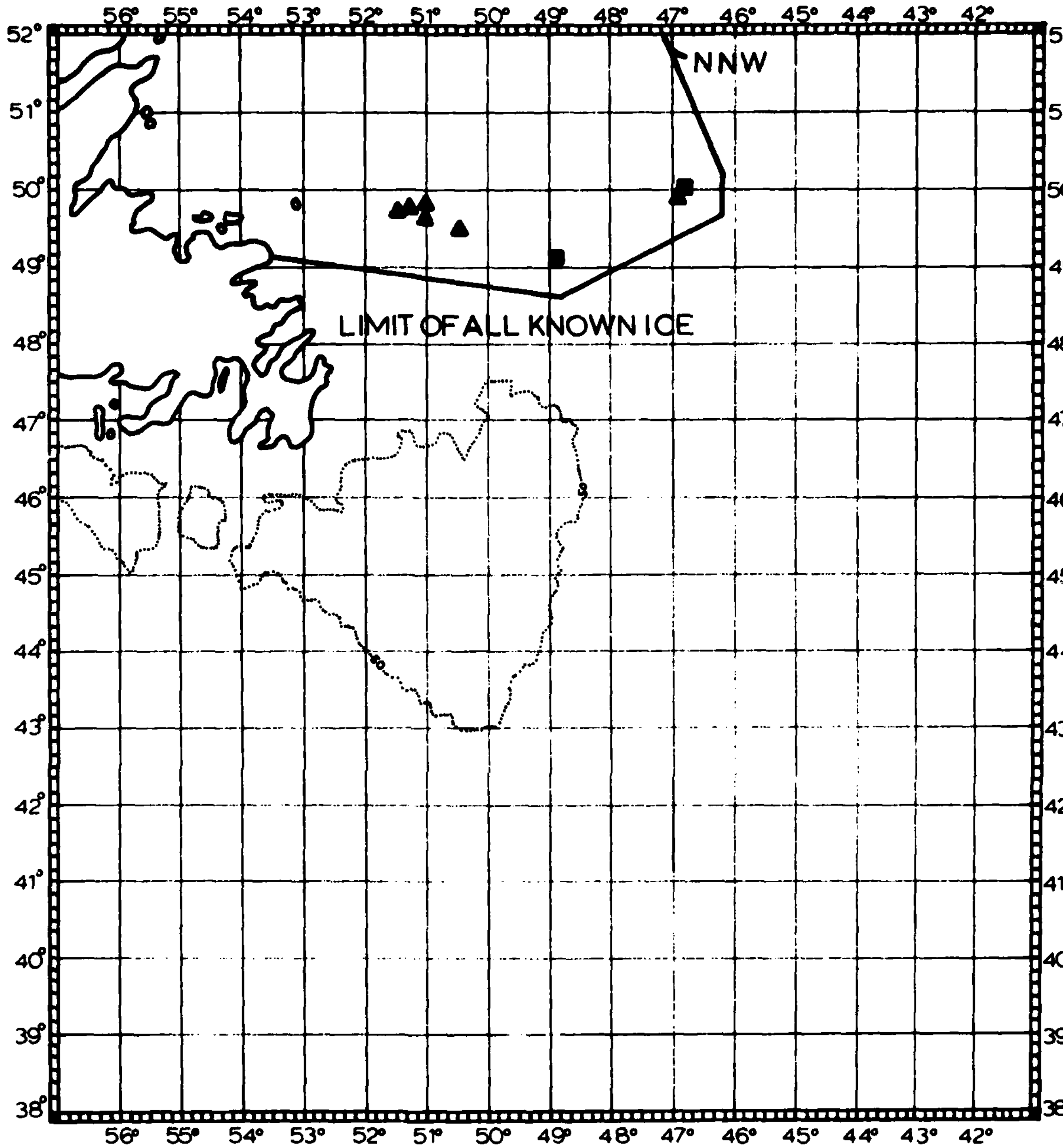


Figure 32.—ISOTHERM CHART BASED ON CURRENT TIROS AND SST DATA IN CONJUNCTION WITH MOST RECENT NAVAL EASTERN OCEANOGRAPHIC COMMAND COMPUTER PROGNOSIS.

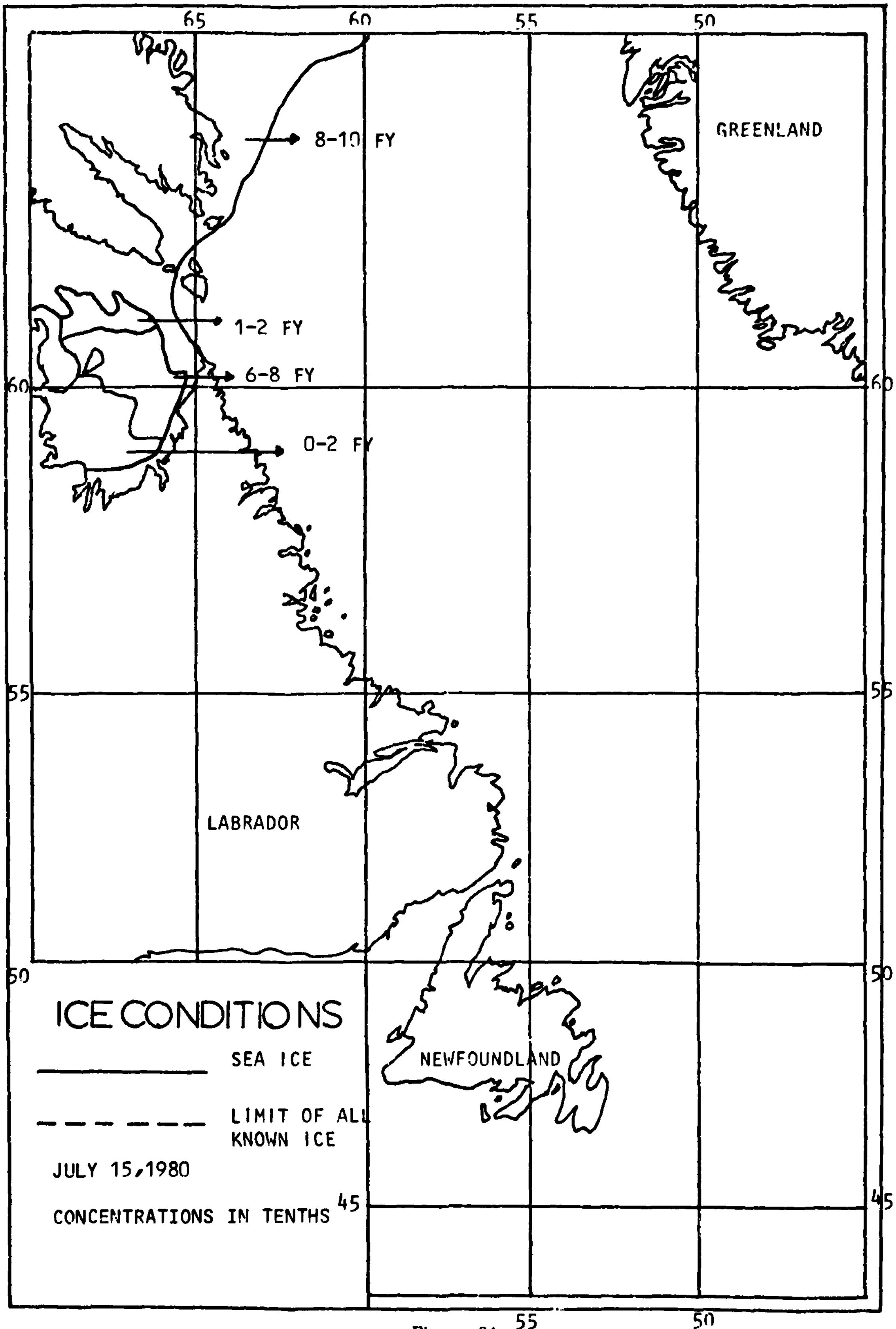


ICE CONDITIONS
FOR 1200 GMT 30 JUNE
BASED ON OBSERVED AND
FORECAST CONDITIONS.

▲ BERG
■ GROWLER
× RADAR TARGET

SEA ICE CONCENTRATION
LESS THAN 6 OKTAS
6 OKTAS OR MORE

Figure—33


65
60
55
50
GREENLAND
8-10 FY
1-2 FY
6-8 FY
0-2 FY
60
55
LABRADOR
50
ICE CONDITIONS
SEA ICE
LIMIT OF ALL KNOWN ICE
NEWFOUNDLAND
JULY 15, 1980
CONCENTRATIONS IN TENTHS
45
55
50

Figure—34

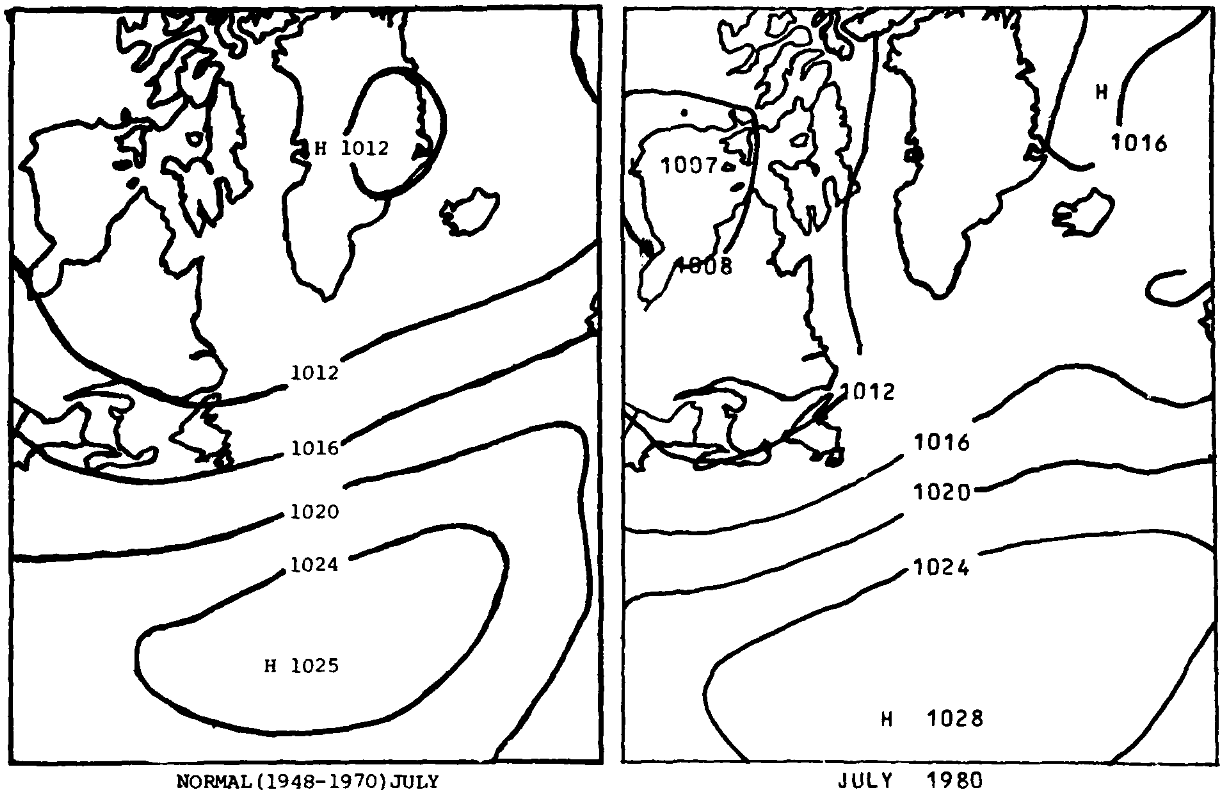


Figure 35.—July 1980-Normal and Monthly Average Surface Pressure in MB

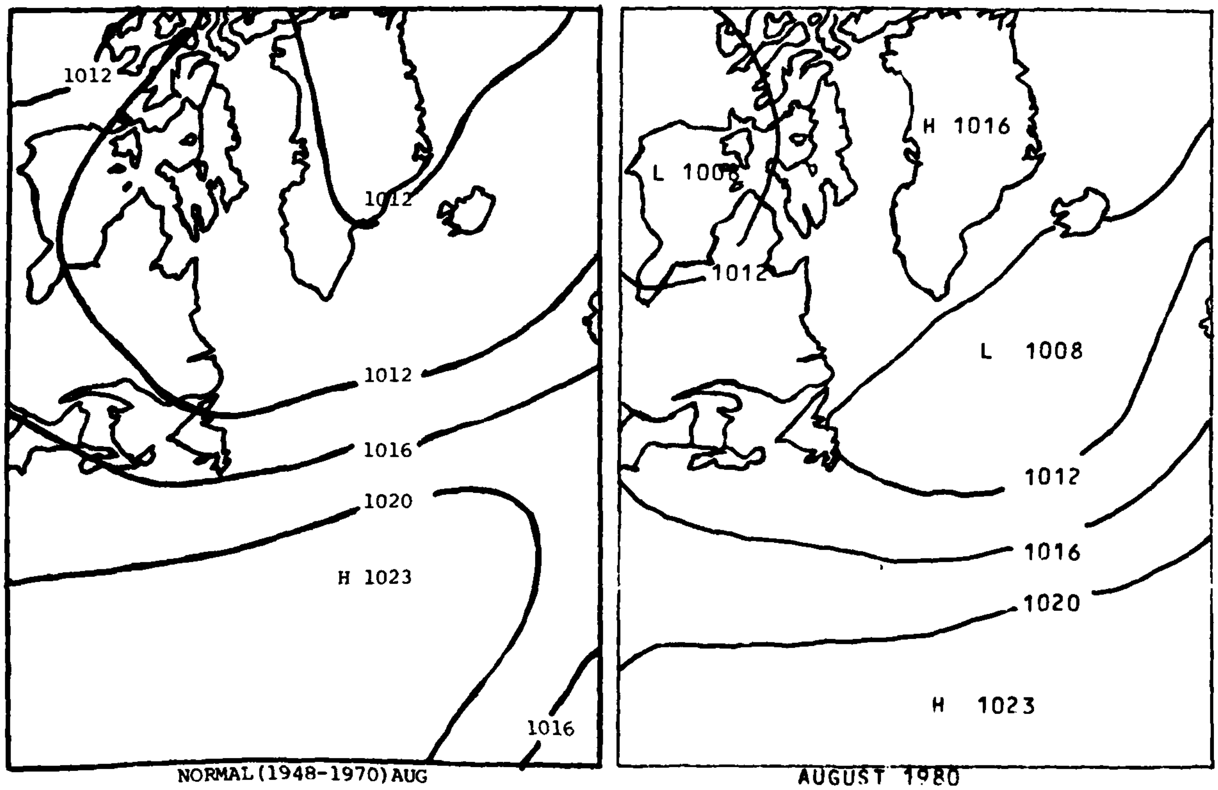
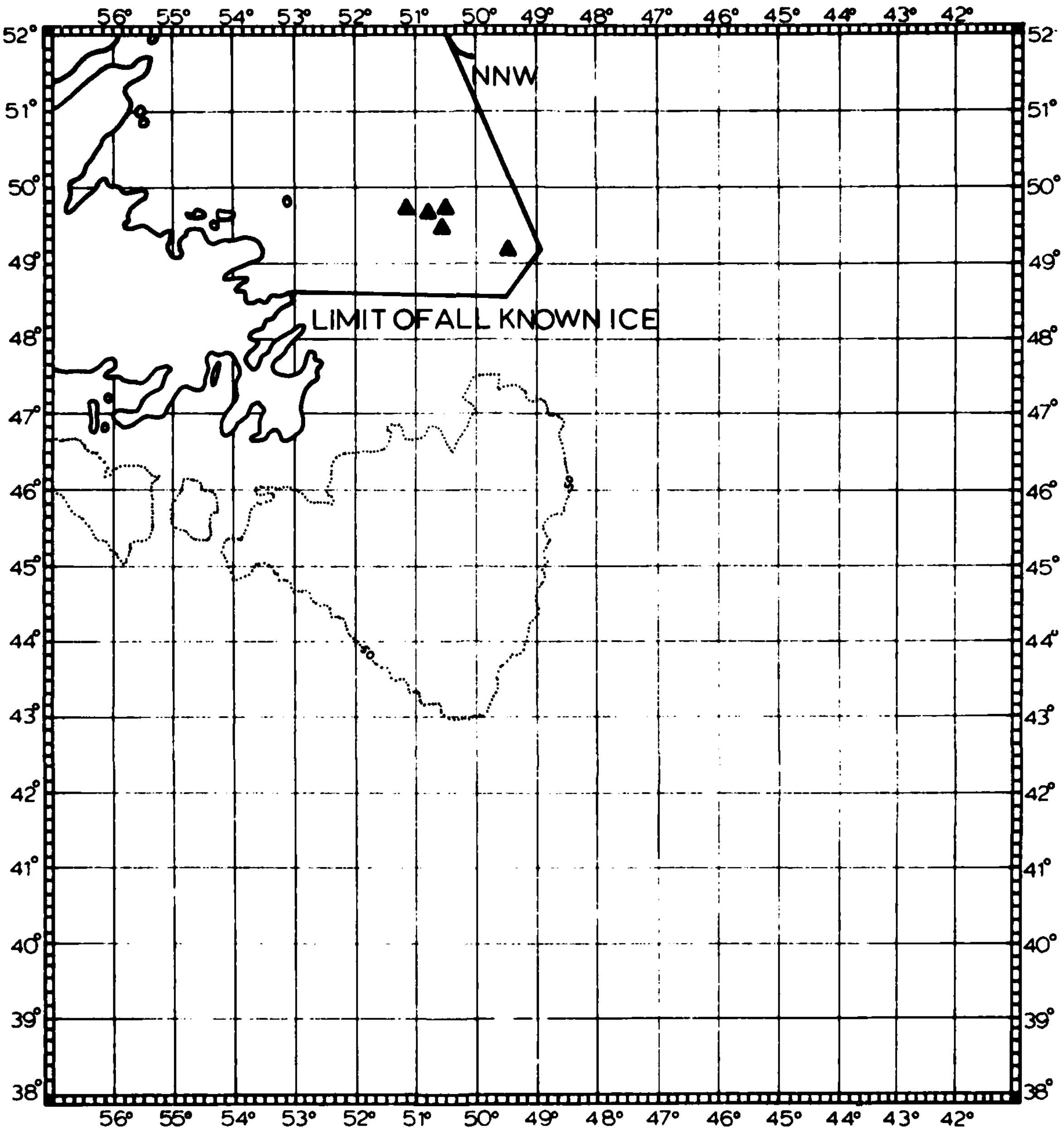


Figure 36.—August 1980-Normal and Monthly Average Surface Pressure in MB

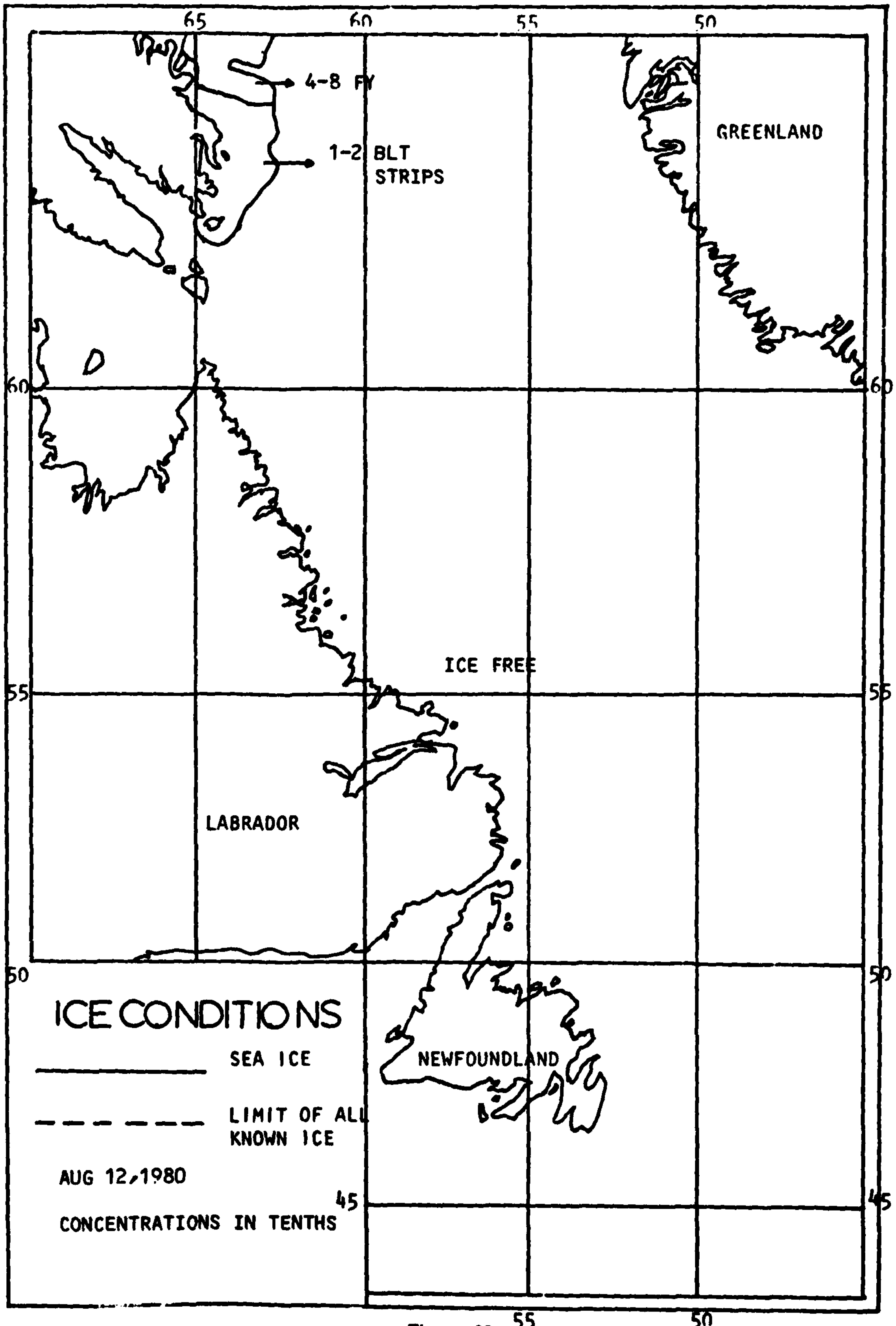


ICE CONDITIONS
FOR 1200 GMT 03 JULY
BASED ON OBSERVED AND
FORECAST CONDITIONS

▲ BERG
■ GROWLER
× RADAR TARGET

SEA ICE CONCENTRATION
LESS THAN 6 OKTAS
6 OKTAS OR MORE

Figure—37


65
60
55
50
4-8 FY
1-2 BLT
STRIPS
GREENLAND
60
ICE FREE
55
LABRADOR
50
ICE CONDITIONS
SEA ICE
LIMIT OF ALL
KNOWN ICE
NEWFOUNDLAND
AUG 12,1980
CONCENTRATIONS IN TENTHS
45
55
50

Figure—38

APPENDIX A
INTERNATIONAL ICE PATROL ICE AND SST REPORTS FOR 1980

COUNTRY OF REGISTRY	SHIPS	TOTAL ICE REPORTS	TOTAL SST REPORTS
CANADA	IRVING ARCTIC (VGLN)	1	
	RUDER BOSKOVIC (UTUR)		6
	M/V ASIA CULTURE (CKNC)		1
	CTU 302.2.3	4	
FINLAND	PETER (D1DT)		2
FRANCE	PELICAN (FNJF)		2
GREECE	M/V NICHOLAS PAPLIOS (SWQD)		1
	M/V MOUNTOTHRYS (SWYX)		2
	MASTER M/V ASTERION (JYBG)		1
	M/V LENA (SXAD)		1
	M/V ASTERFUN (J4BG)		1
	ARISTARCHOS (SWAZ)		1
HONDURAS	RIO SULACO (HQID)		1
ICELAND	MASTER BRUARFOSS (TFUA)	2	
	SELFOSS (TFEB)		1
	ISNES (TFEW)	1	
INDIA	M/V VISH PARIJAT (ATVC)	1	
JAPAN	TERUTO KUMARU (JHTE)	1	
LIBERIA	BORNHEIM (D5TF)	1	
	KANSAS GETTY (D5OP)		6
	SOUTHERN LION (A8SF)	1	
	NORTH EMPEROR (6ZHT)	1	1
	FIRMNESS (D5NA)	1	
	CERISIO (6ZHT)		1
	ASIA CULTURE (ELKN)		1
NORWAY	DRYSO (CGNR)	1	
	LAKE ANIARA (D5LV)		3
	AINO (LFXJ)		4
POLAND	ZIEMIA OLSZTYNSKA (SQDR)	2	
	FRANCISZEK ZUBRZYCKI (SQDE)	1	
	GENERAL MADALINSKI (SQEM)	1	
SPAIN	POLADE LAVINA (EHBL)		1
	LAURO PANDO (EHRZ)		3
SWEDEN	ATLANTIC PREMIER (SFNH)	1	
UNITED KINGDOM	VENETIA (GUKX)		7
	CP TRADER (GNAR)	1	
	M/V RIVERINA (GVUC)	2	
	SAMIA (GYOA)		2
	L.C. CROSBIE (GPUD)	1	
	RAVENSCRAIG (GBDT)		1
	ATLANTIC CONVEYER (GZMM)	1	
	ATLANTIC PROJECT (GXXY)	1	
UNITED STATES	USCGC EVERGREEN (NRXD)	16	146
	USCGC NORTHWIND (NRFJ)	1	
	USNS LYNCH (NEKF)		1
W. GERMANY	M/V PROSPERINA (DNDV)		13
YUGOSLAVIA	M/V ORJEN		
	M/V IVOVOJNOVIC		5
UNKNOWN	WM NEAL NR R	1	

APPENDIX B
OCEANOGRAPHIC CONDITIONS
LT J.J. Murray, U.S. Coast Guard

From an oceanographic standpoint, the 1980 season was conducted in essentially the same manner as the 1979 season and as discussed in the report on the 1979 IIP season (CG-188-34). For the second successive season, satellite tracked buoy transmitting terminals (BTTs) were used exclusively to measure currents and verify the IIP current file. IBERG, the computer model to predict the drift of icebergs, was again used without any significant operational problems.

During the 1980 season, seven BTTs were deployed (table 1). Three BTTs, 2610, 2630, and 2613, were deployed in the Labrador Current; three BTTs, 2632, 2634, and 2636 were deployed in the northern part of the IIP region, and to the west of the Labrador Current; BTT 2633 was deployed in the northwest corner of the IIP region inconjunction with an iceberg tagging project. The preponderance of deployments in the extreme northern part of the IIP region was due to the light ice year and the fact that, in general, icebergs could be found only in these northern areas, thus intensifying interest in the currents there. All BTTs functioned well throughout the season with two exceptions. BTT 2610 indicated a loss of drogue on 20 March 1980, and BTT 2633 suffered a failure of the temperature sensor on deployment. Data on the average and total number of positions for each BTT are also included in Table 1.

The drifts of the various BTTs are depicted in Figures 1-7. As in the 1979 buoy drift analyses, these figures were generated by a computer program utilizing a cubic spline routine to smooth the drifts. Actual input positions are indicated by Xs on these figures, and are periodically labeled with the Julian date. Not all input positions are indicated on the figures but these are listed in Tables 2 a-g.

Two significant changes from the 1979 mode of operations made it possible both to obtain more accurate buoy positions and to estimate these accuracies. Prior to the onset of the 1980 season and with the help of the Canadian government, the Oceanographic Unit established two reference beacons on the roof of the Canadian Coast Guard building in St. John's Newfoundland. The proximity of these references to the IIP region itself guaranteed positions would approach maximum accuracy. This was confirmed by periodic comparisons with positions obtained from Service ARGOS, the French organization which operates a worldwide data collection and location system for platforms transmitting to the TIROS-N and NOAA-6 satellites. For drifting buoys Service ARGOS claims to be accurate to within ±3km in 99% of all cases. Positions obtained using the Oceanographic Unit's Local User Teminal (LUT) were within an average of ±2 km of the ARGOS positions for the 534 comparisons attained during the 1980 IIP season, and 90% of all LUT positions were within ±4 km of the ARGOS positions.

The smoothed BTT drifts were analyzed in the same manner as during the 1979 season to determine the validity of the IIP current file. The basis for determining whether or not changes to the IIP current file were warranted was subjective scientific evaluation considering such factors as the magnitude of differences between current file values and those obtained from analyzed BTT drifts, the time of season, ice conditions, and the reliability of measurements. As in 1979, no changes were made to the IIP current file in 1980.

REFERENCE

Murray, J.J. (1979). "Oceanographic Conditions", Report of the International Ice Patrol Service in the North Atlantic Ocean, Season of 1979. Coast Guard 188-34, Bulletin No. 65.

Table 1—*BTT DATA*

Buoy ID	*Date*	*Deployment Latitude*	*Deployment Longitude*	*Positions Total*	*Temperatures Per Week*
2610	29 February	48-15	47-59	104	6
2630	28 March	49-00	50-00	104	7
2632	28 March	49-00	50-50	105	7
2634	29 April	50-10	52-00	68	7
2613	21 May	50-00	50-00	37	6
2636	21 May	49-00	51-00	35	6
2633	9 June	51-46	54-56	*28	0

Latitude and longitude are in degrees-minutes North and West, respectively.
*Temperature sensor failed on deployment.

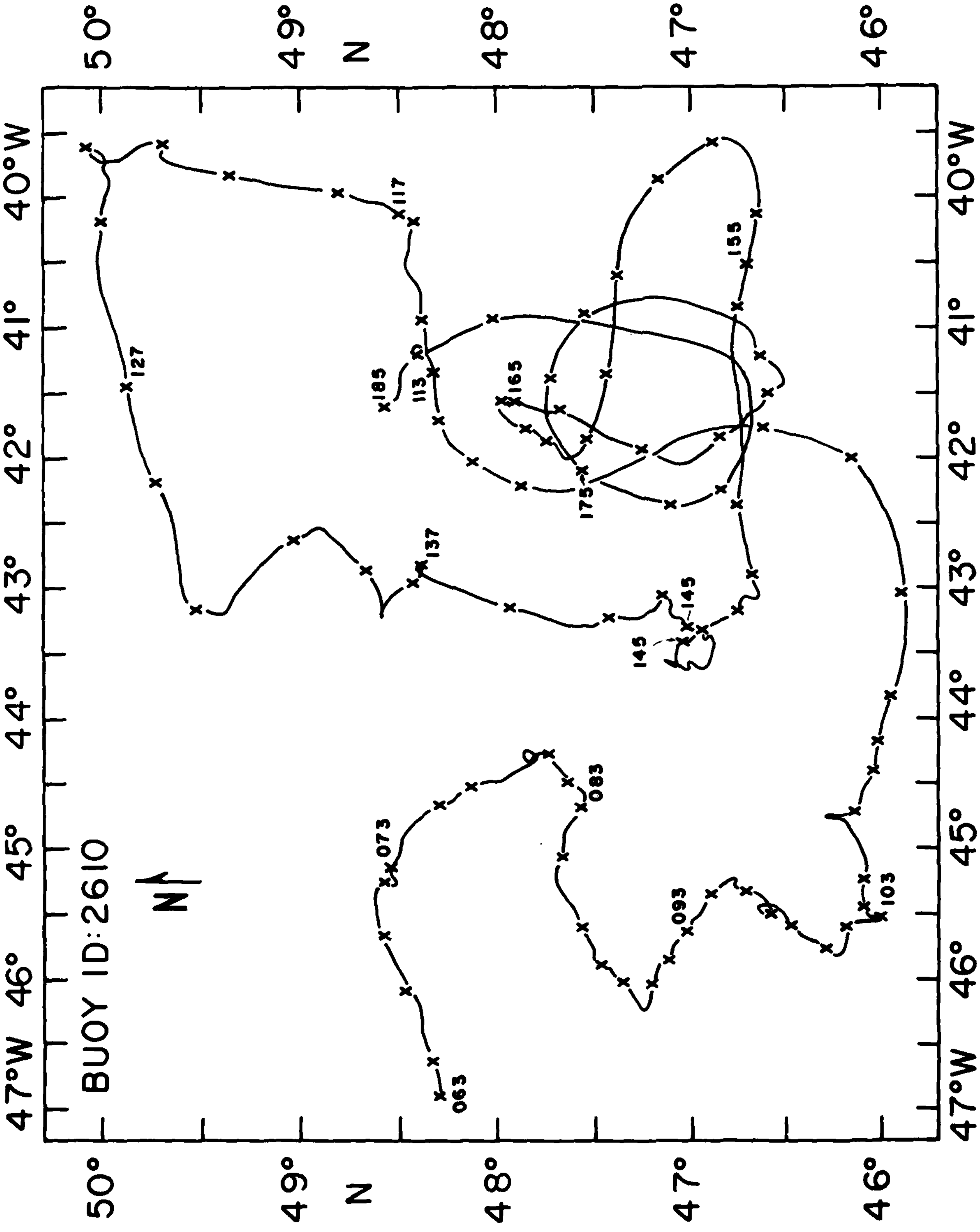


Figure 1.--BTT 2610 Drift

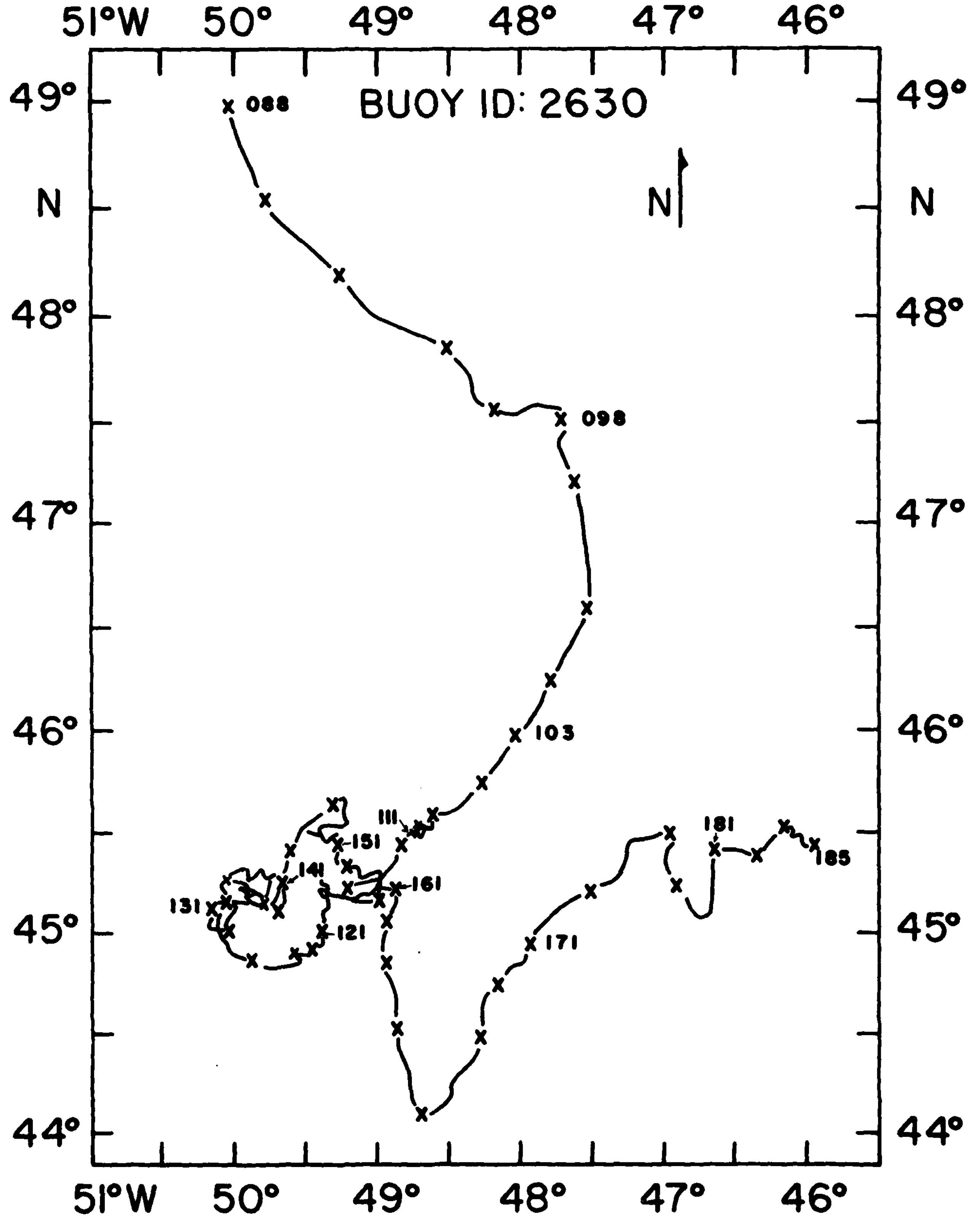


Figure 2.—BTT 2630 Drift

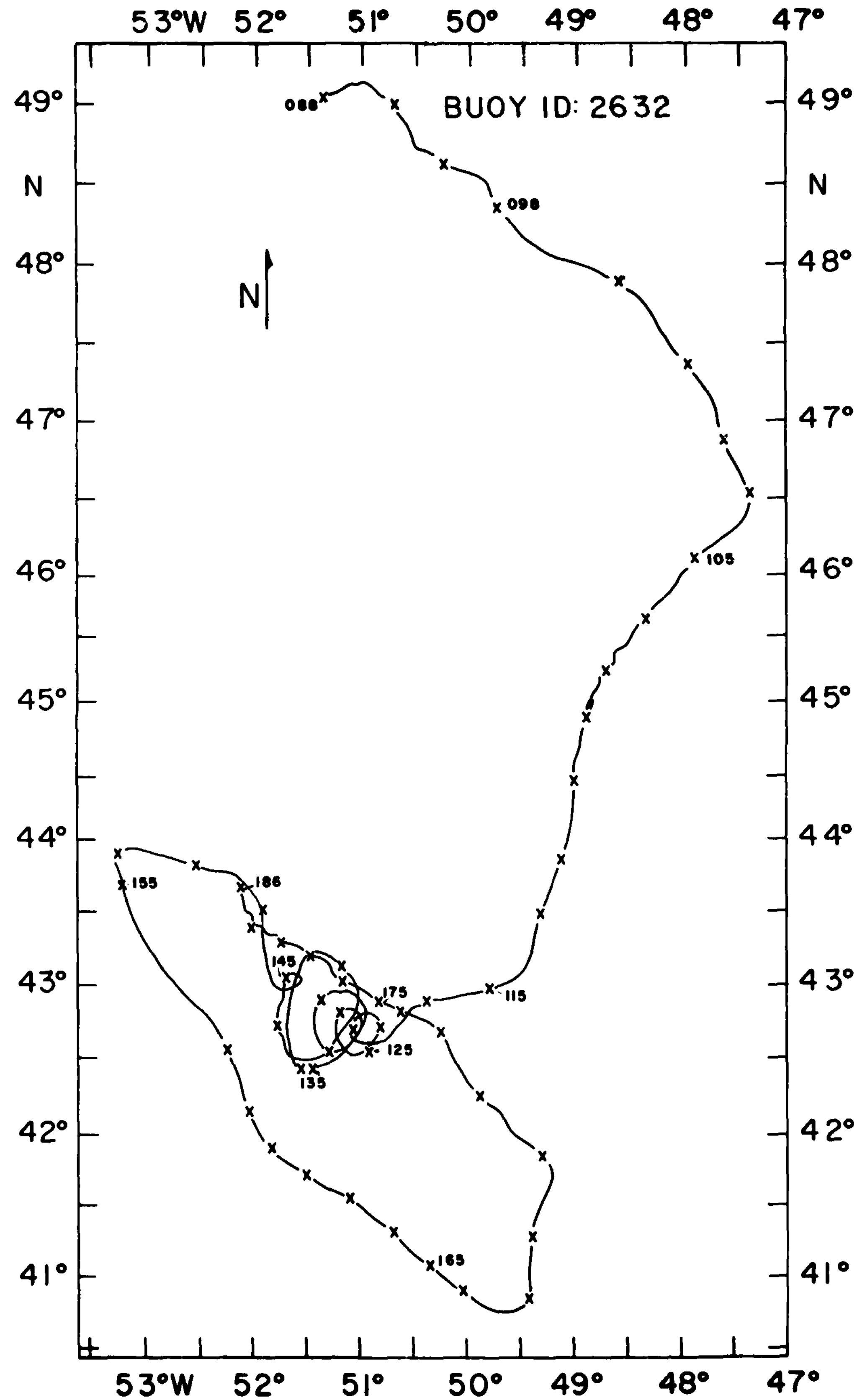


Figure 3.—BTT 2632 Drift

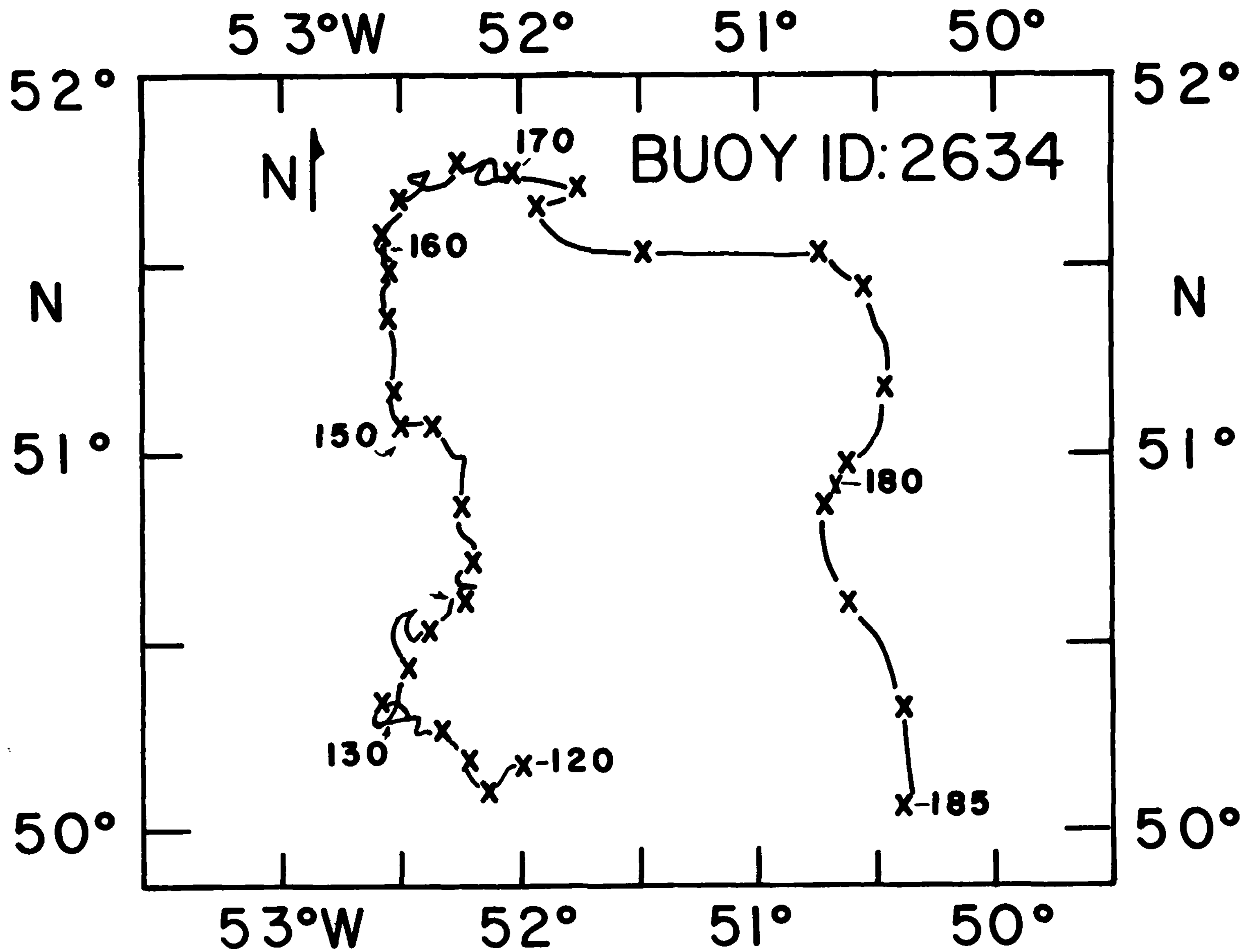


Figure 4.—BTT 2634 Drift

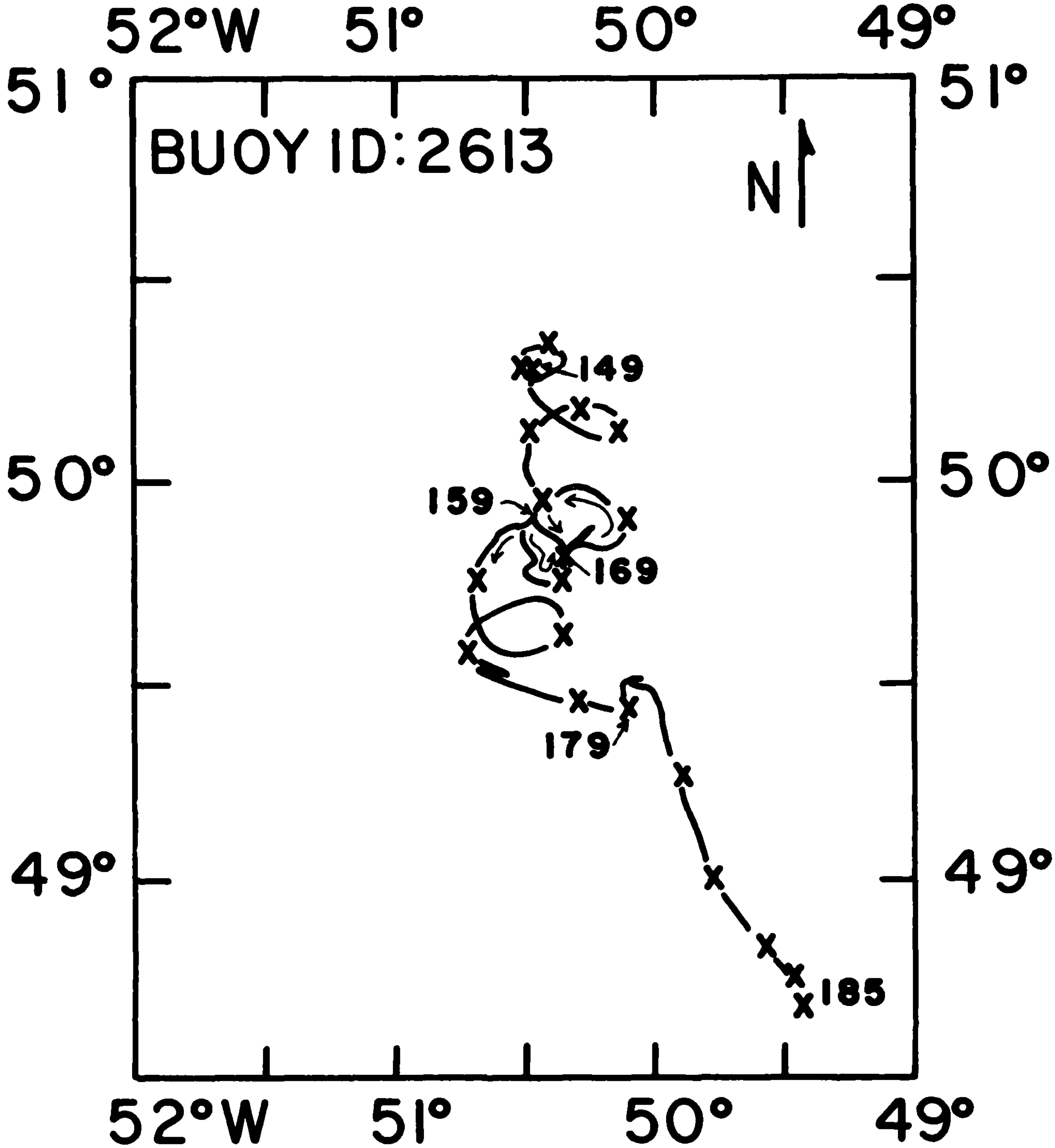


Figure 5.—BTT 2613 Drift

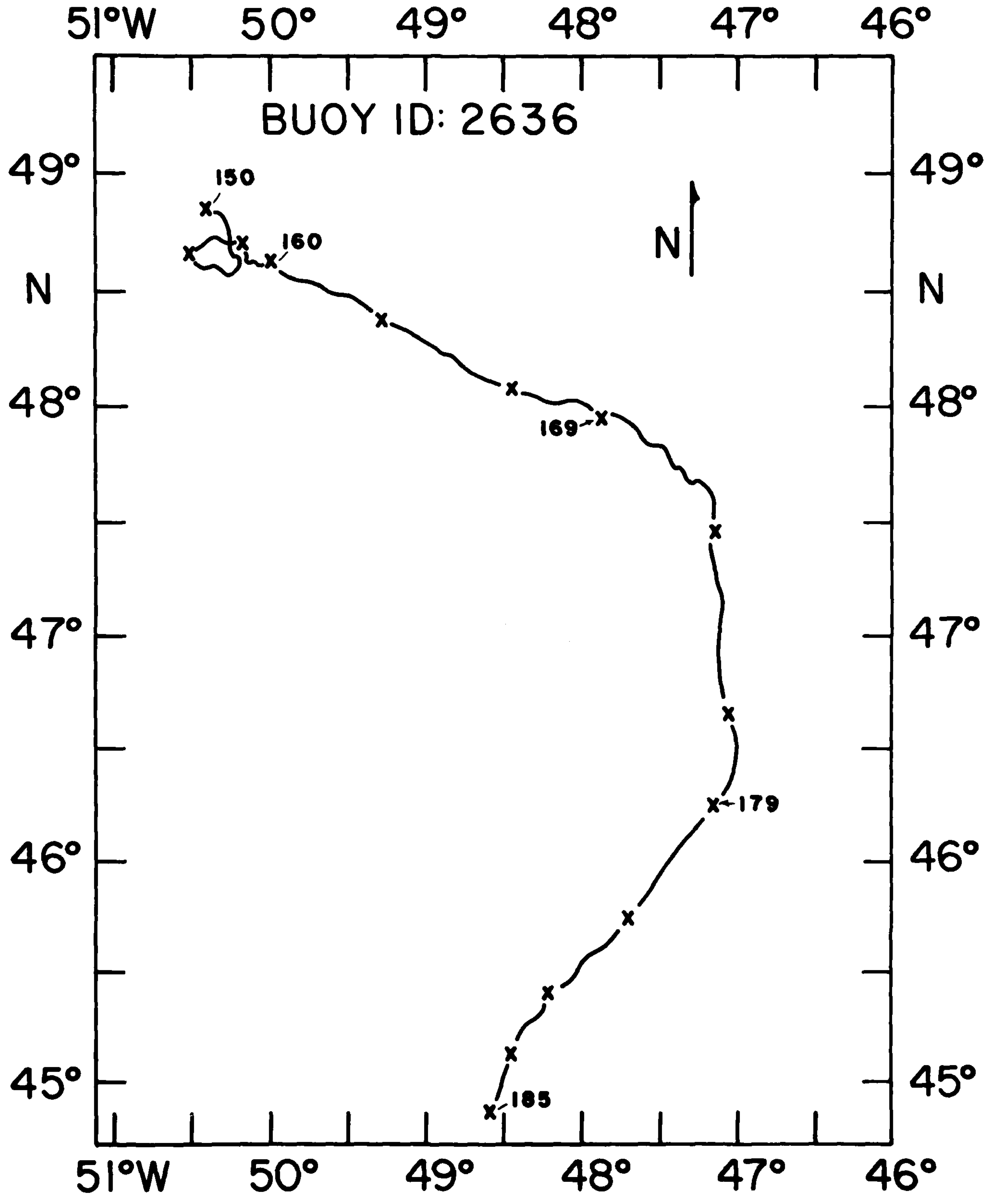


Figure 6.—BTT 2636 Drift

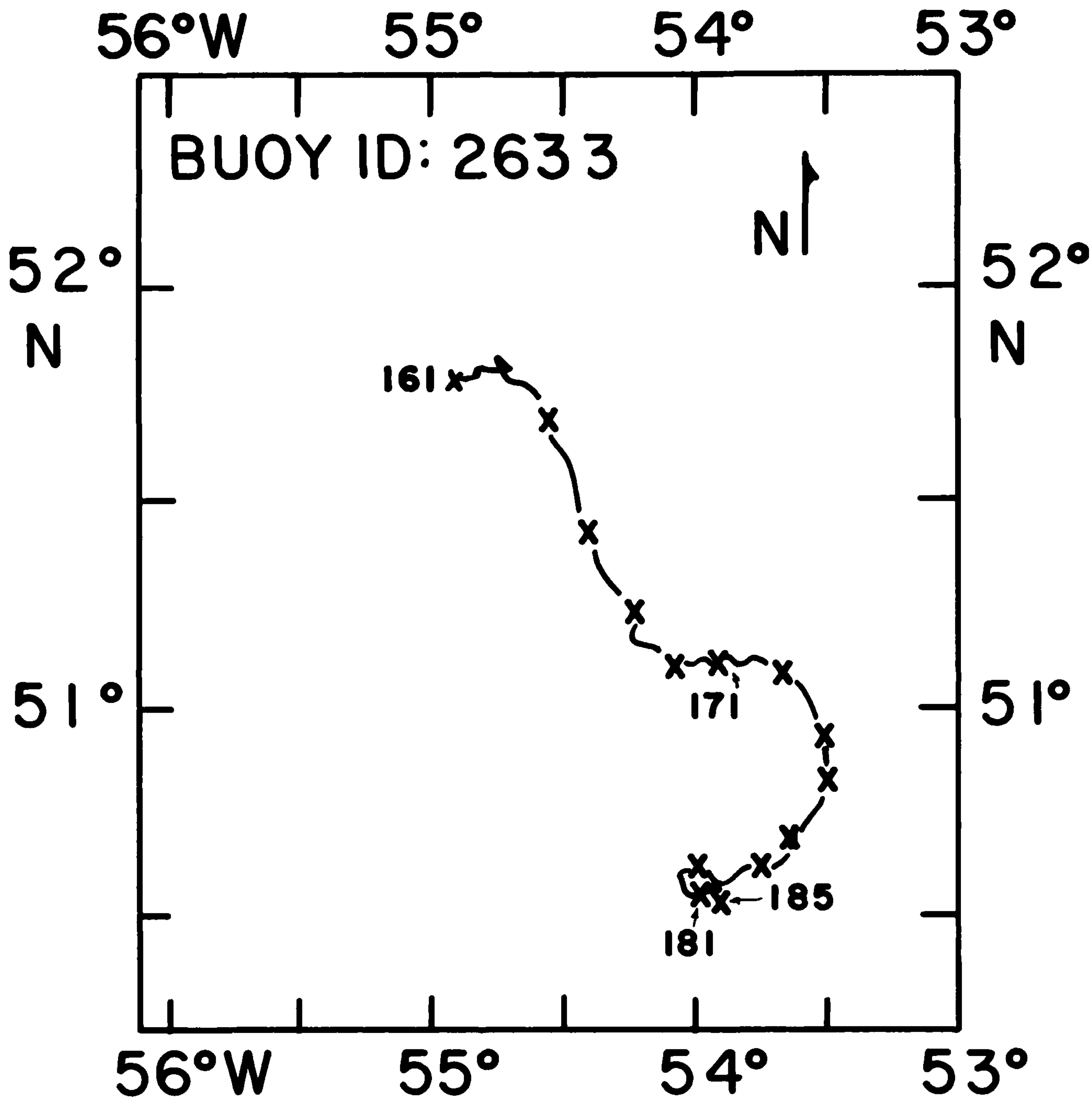


Figure 7.—BTT 2633 Drift

Table 2

BTT POSITIONS

LATITUDE IN DEGREES AND HUNDRETHS NORTH
LONGITUDE IN DEGREES AND HUNDRETHS WEST
DTG IS JULIAN DAY, ZULU(Z) HOURS AND MINUTES

TABLE 2a. BTT 2810 POSITIONS

LAT	LON	DTG
48.29	046.89	063.06.02
48.32	046.66	064.09.12
48.34	046.57	064.15.42
48.39	046.35	065.09.00
48.38	046.35	065.10.35
48.43	046.10	066.05.31
48.53	045.89	066.23.18
48.59	045.68	067.13.09
48.57	045.27	070.12.05
48.53	045.24	072.09.23
48.55	045.21	072.15.51
48.55	045.17	073.09.12
48.50	045.03	074.05.44
48.49	044.98	074.12.1[illegible]
48.29	044.67	076.23.00
48.20	044.61	077.22.39
48.14	044.54	078.12.31
48.02	044.50	078.20.36
47.91	044.42	079.06.27
47.85	044.37	079.13.46
47.80	044.30	080.06.18
47.86	044.26	080.19.29
47.84	044.34	081.06.07
47.80	044.27	081.13.04
47.74	044.28	081.19.29
47.66	044.44	082.09.15
47.62	044.50	082.12.42
47.57	044.55	082.19.07
47.56	044.69	083.09.01
47.58	044.72	083.12.22
47.61	044.78	083.18.56
47.65	044.92	084.05.26
47.67	045.09	084.12.01
47.72	045.21	084.18.34
47.64	045.42	085.05.15
47.60	045.52	085.13.16
47.56	045.62	085.1[illegible].34
47.53	045.76	086.05.08
47.50	045.81	086.12.56
47.51	045.87	086.20.03
47.47	045.91	087.06.42
47.42	045.94	087.16.31
47.42	045.97	087.23.59
47.38	046.00	088.09.48
47.35	046.03	088.16.20
47.25	046.23	089.21.36
47.23	046.23	090.09.2[illegible]
47.20	046.15	90.15.57
47.19	046.05	090.22.4[illegible]
47.18	045.99	091.05.52
47.17	045.89	091.12.46
47.16	045.87	091.19.08
47.15	045.88	092.00.11
47.12	045.57	092.12.26
47.09	045.73	092.1[illegible].57
47.00	045.65	093.0[illegible].33
46.99	045.56	093.12.03
46.96	045.53	093.1[illegible].4[illegible]
46.89	045.36	094.10.01
46.84	045.30	094.18.34
46.77	045.25	095.12.59
46.77	045.30	095.20.02
46.70	045.34	096.05.39
46.64	045.36	096.12.38
46.62	045.39	096.19.50
46.58	045.50	097.06.20
46.63	045.50	097.16.14
46.63	045.49	097.23.38
46.65	045.46	098.06.20
46.63	045.45	098.13.32
46.58	045.44	098.19.59
46.47	045.59	099.06.58
46.44	045.67	099.13.11
46.42	045.69	099.19.19
46.23	045.78	100.11.11
46.24	045.83	100.17.24
46.20	045.77	101.05.46
46.19	045.70	101.12.29

LAT	LON	DTG
46.18	045.61	101.18.57
46.12	045.57	102.05.29
46.06	045.55	102.16.58
46.04	045.55	102.23.30
45.99	045.55	103.11.46
46.03	045.54	103.19.45
46.09	045.45	104.05.06
46.09	045.24	104.13.02
46.08	045.07	104.20.59
46.17	044.84	105.06.41
46.20	044.76	105.12.41
46.31	044.76	105.20.46
46.14	044.73	106.06.32
46.11	044.58	106.16.18
46.03	044.42	106.23.38
46.02	044.19	107.06.20
45.95	043.84	107.13.29
45.87	043.59	107.20.01
45.87	043.03	108.06.08
45.91	042.63	108.13.12
46.00	042.35	108.19.39
46.16	041.99	109.05.53
46.38	041.85	109.12.49
46.61	041.77	109.19.01
47.04	041.85	110.05.43
47.27	042.03	110.12.25
47.42	042.12	110.18.56
47.60	042.26	111.05.34
47.72	042.26	111.12.06
47.87	042.22	111.18.46
48.12	042.05	112.05.22
48.25	041.88	112.11.49
48.29	041.72	112.18.35
48.33	041.34	113.04.43
48.36	041.22	113.19.31
48.36	041.08	114.04.52
48.34	040.94	114.12.43
48.42	040.69	115.06.31
48.47	040.53	115.16.21
48.44	040.40	115.23.46
48.44	040.33	116.06.17
48.43	040.26	116.16.03
48.43	040.22	116.23.25
48.42	040.21	117.06.08
48.43	040.21	117.13.16
48.48	040.18	117.19.20
48.57	040.06	118.04.14
48.65	040.04	118.19.08
48.60	039.97	119.05.39
48.95	039.94	119.12.34
49.13	039.92	119.18.57
49.34	039.84	120.05.34
49.47	039.82	120.12.12
49.57	039.77	120.18.46
49.70	039.70	121.05.21
49.69	039.60	121.13.27
49.69	039.60	121.19.51
49.74	039.57	122.11.24
49.81	039.61	122.18.22

LAT	LON	DTG
50.02	039.74	123.06.34
50.06	039.61	123.12.41
49.98	039.72	123.20.53
49.98	039.80	124.04.45
49.96	039.86	124.10.46
49.96	039.96	124.20.31
49.99	040.20	125.04.36
49.99	040.33	125.16.10
50.02	040.50	125.23.30
50.01	040.63	126.06.07
49.97	040.82	126.15.58
49.93	040.97	126.23.09
49.91	041.12	127.05.55
49.88	041.28	127.12.58
49.87	041.44	127.18.58
49.77	042.10	128.10.52
49.68	042.34	128.17.17
49.63	042.61	129.00.01
49.60	042.96	129.10.36
49.57	043.15	129.18.46
49.48	043.19	130.05.21
49.44	043.22	130.11.55
49.41	043.21	130.18.34
49.37	043.19	131.05.10
49.35	043.10	131.11.32
49.30	042.99	131.18.21
49.19	042.83	132.05.41
49.18	042.82	132.12.45
49.09	042.67	132.19.52
48.97	042.61	133.06.30
48.91	042.55	133.16.13
48.89	042.56	133.22.15
48.88	042.59	134.06.16
48.84	042.65	134.13.42
48.84	042.65	134.13.42
48.77	042.72	134.23.28
48.75	042.79	135.06.05
48.68	042.87	135.13.20
48.62	042.94	135.21.21
48.58	043.16	136.09.13
48.59	043.22	136.15.46
48.59	043.13	136.22.47
48.52	043.06	137.05.40
48.43	042.97	137.12.40
48.39	042.88	137.18.56
48.39	042.85	138.05.32
48.40	042.83	138.12.19
48.42	042.87	138.18.45
48.36	042.93	139.05.13
48.28	042.99	139.13.33
48.22	043.01	139.18.34
48.04	043.12	140.06.53
47.94	043.17	140.13.12
47.85	043.20	140.18.20
47.67	043.29	141.06.35
47.59	043.32	141.12.51
47.52	043.30	141.20.52
47.49	043.31	142.06.26
47.42	043.23	142.12.31

LAT	LON	DTG
47.30	043.24	142.19.40
47.20	043.19	143.06.15
47.17	043.17	143.13.45
47.14	043.09	143.20.08
47.12	043.11	144.05.59
47.10	043.12	144.13.23
47.11	043.20	144.19.52
47.10	043.24	145.05.54
47.04	043.26	145.13.04
47.02	043.33	145.17.22
45.93	043.33	146.05.42
46.92	043.40	146.12.43
46.90	043.37	146.18.55
46.88	043.50	147.10.41
46.91	043.63	147.17.03
47.01	043.59	148.05.18
47.02	043.65	148.13.35
47.12	043.57	148.20.04
47.07	043.60	149.09.57
47.08	043.47	149.16.41
47.03	043.43	149.19.42
46.99	043.42	150.06.40
46.93	043.32	150.12.54
46.85	043.26	150.19.44
46.74	043.18	151.09.11
46.74	043.12	151.17.56
46.73	043.11	151.23.57
46.72	043.08	152.06.18
46.68	043.08	152.16.01
46.64	043.10	152.23.36
46.64	043.07	153.06.07
46.68	042.93	153.13.26
46.70	042.76	153.19.54
46.75	042.34	154.05.51
46.72	041.93	154.13.06
46.76	041.53	154.19.29
46.76	040.85	155.12.43
46.71	040.54	155.20.49
46.65	040.13	156.08.57
46.66	039.93	156.15.17
46.69	039.70	156.22.09
46.88	039.57	157.10.19
47.00	039.67	157.16.47
47.16	039.85	157.23.26
47.35	040.24	158.10.00
47.39	040.62	158.19.44
47.44	041.37	159.12.56
47.46	041.59	159.19.48
47.54	041.88	160.09.45
47.[illegible]	041.97	160.16.16
47.65	042.02	160.22.20
47.69	041.93	161.09.33
47.73	041.89	161.15.57
47.73	041.82	161.23.39
47.81	041.83	162.09.22
47.85	041.78	162.19.17
47.85	041.78	162.23.11
47.90	041.78	163.09.13
47.94	041.75	163.19.35
47.96	041.73	163.22.55

LAT	LON	DTG
47.98	041.59	164.17.07
47.97	041.59	164.18.54
47.96	041.58	164.22.33
47.93	041.62	165.09.04
47.93	041.57	165.16.59
47.84	041.63	165.23.50
47.77	041.65	166.10.25
47.75	041.68	166.16.50
47.69	041.65	166.23.23
47.50	041.60	167.09.59
47.39	041.57	167.16.39
47.07	042.04	168.09.33
46.98	042.01	168.18.08
46.92	041.95	168.22.45
46.84	041.86	169.10.56
46.72	041.74	169.19.37
46.71	041.72	169.22.22
47.24	041.96	169.23.08
46.72	041.71	170.00.02
46.62	041.60	170.12.15
46.60	041.51	170.23.40
46.65	041.37	171.09.22
46.63	041.23	171.15.52
46.67	041.09	171.23.18
46.74	040.97	172.09.12
47.01	040.81	172.12.58
46.88	040.87	172.17.23
47.37	040.81	173.15.30
47.47	040.35	173.18.52
47.56	040.93	173.22.28
47.74	041.42	174.10.49
47.74	041.68	174.15.42
47.69	041.88	174.23.52
47.56	042.12	175.10.18
47.53	042.15	175.12.06
47.10	042.37	176.19.49
47.08	042.38	176.21.25
47.07	042.38	176.23.08
47.00	042.36	177.11.24
46.97	042.34	177.18.07
46.94	042.33	177.22.47
46.91	042.30	178.09.18
46.82	042.25	178.19.35
46.81	042.20	179.00.03
46.68	041.65	180.09.21
46.71	041.42	180.17.33
46.75	041.30	180.23.21
46.91	041.14	181.09.09
47.15	041.05	181.19.02
47.41	041.00	182.09.32
47.57	040.96	182.18.51
48.02	040.95	183.10.49
48.17	041.04	183.1[illegible].59
48.38	041.22	183.23.54
48.42	041.13	184.10.28
48.46	041.29	184.16.42
48.50	041.36	184.23.33
48.52	041.59	185.08.17
48.58	041.64	185.13.15
48.58	041.59	185.22.57

TABLE 2b. BTT 2630 POSITIONS

LAT	LON	DTG
49.00	049.99	088.20.17
48.81	049.89	089.21.37
48.72	049.83	090.09.25
48.66	049.80	090.15.58
48.56	049.72	090.22.56
48.48	049.64	091.05.53
48.43	049.54	091.12.45
48.36	049.44	091.19.02
48.23	049.19	092.09.06
48.11	049.04	092.17.14
48.05	048.96	092.23.51
47.98	048.70	093.10.15
47.94	048.58	093.17.05
47.89	048.44	093.23.29
47.81	048.32	094.10.01
47.76	048.26	094.16.54
47.72	048.23	094.23.08
47.64	048.21	095.11.21
47.62	048.15	095.18.22
47.61	048.08	096.00.25
47.58	047.97	096.05.40
47.62	047.82	096.16.31
47.64	047.77	096.22.22
47.64	047.76	097.06.31
47.62	047.71	097.13.53
47.62	047.63	097.20.17
47.57	047.63	098.09.36
47.54	047.58	098.16.09
47.47	047.63	098.23.20
47.44	047.62	099.05.08
47.36	047.57	099.13.12
47.28	047.52	099.19.19
47.02	047.44	100.11.12
46.92	047.43	100.17.25
46.81	047.41	101.00.15
46.67	047.41	101.09.03
46.56	047.47	101.15.35
46.44	047.55	101.23.54
46.31	047.65	102.10.27
46.21	047.78	102.18.41
46.04	047.91	103.10.05
45.95	048.03	103.18.35
45.80	048.16	104.13.03
45.73	048.26	104.19.53
45.62	048.41	105.12.32
45.57	048.52	105.23.51
45.57	048.61	106.10.39
45.50	048.62	106.19.41
45.57	048.64	107.06.18
45.47	048.69	107.17.46
45.47	048.69	108.06.06
45.45	048.73	108.13.12
45.50	048.68	108.19.19
45.53	048.70	109.05.56
45.54	048.73	109.12.47
45.53	048.69	109.19.03
45.51	048.70	110.05.41
45.51	048.71	110.12.33
45.51	048.69	110.15.56
45.50	048.71	111.05.34
45.49	048.73	111.12.11
45.49	048.76	111.18.45
45.42	048.83	112.05.22
45.36	048.84	112.11.45
45.32	048.90	112.18.34
45.24	048.98	113.05.10
45.19	049.02	113.13.06
45.19	049.07	113.20.03
45.17	049.12	114.06.43
45.16	049.17	114.19.52
45.18	049.20	115.06.31
45.17	049.22	115.16.16
45.20	049.22	115.23.45
45.17	049.24	116.06.16
45.18	049.27	116.13.39
45.18	049.31	116.21.46
45.16	049.32	117.06.08
45.18	049.32	117.13.18
45.17	049.35	117.19.19
45.22	049.38	118.09.14
45.21	049.35	118.15.45
45.24	049.39	118.22.40
45.23	049.34	119.12.35
45.18	049.34	119.20.39
45.11	049.32	120.05.33
45.09	049.37	120.12.13
45.04	049.35	120.18.45
45.02	049.36	121.05.20
45.00	049.38	121.11.52
44.95	049.36	121.18.34
44.93	049.45	122.13.04
44.91	049.46	122.20.02
44.83	049.49	123.05.43
44.89	049.56	123.12.48
44.86	049.53	123.20.52
44.86	049.57	124.00.11
44.85	049.61	124.12.25
44.82	049.68	124.20.30
44.86	049.86	125.09.35
44.88	049.99	125.13.43
44.94	050.05	125.23.29
44.98	050.07	126.06.08
45.05	050.10	126.17.38
45.06	050.10	126.21.23
45.15	050.07	127.05.56
45.21	050.07	127.17.27
45.22	050.06	127.21.05
45.21	050.07	128.10.53
45.18	050.02	128.17.16
45.16	049.99	128.20.38

LAT	LON	DTG	LAT	LON	DTG
45.14	050.03	129.05.32	45.54	049.21	148.05.18
45.07	050.04	129.18.46	45.53	049.22	148.16.51
45.07	050.04	129.21.57	45.53	049.31	148.23.25
45.05	050.05	130.05.19	45.49	049.39	149.09.57
45.01	050.11	130.16.53	45.47	049.45	149.19.59
45.02	050.11	130.21.39	45.49	049.47	149.23.02
45.03	050.17	131.08.33	45.47	049.40	150.06.39
45.06	050.15	131.16.41	45.48	049.39	150.12.55
45.10	050.18	131.21.17	45.45	049.34	150.22.41
45.15	050.11	132.06.43	45.47	049.32	151.10.43
45.14	050.03	132.12.48	45.48	049.27	151.16.12
45.17	050.03	132.20.51	45.45	049.28	151.23.53
45.15	049.92	133.06.31	45.43	049.25	152.06.18
45.20	049.84	133.16.13	45.36	049.27	152.17.47
45.19	049.82	133.22.14	45.34	049.25	152.21.57
45.18	049.80	134.06.16	45.33	049.21	153.06.06
45.19	049.84	134.17.41	45.30	049.12	153.17.35
45.21	049.92	134.21.52	45.26	049.11	153.21.32
45.21	049.89	135.06.05	45.29	049.04	154.05.51
45.25	049.96	135.17.33	45.27	049.03	154.17.25
45.25	050.02	135.21.30	45.27	049.04	154.22.53
45.29	050.00	136.09.13	45.28	048.96	155.09.22
45.31	049.89	136.17.22	45.26	048.99	155.11.05
45.28	049.89	136.21.07	45.26	049.00	155.12.43
45.29	049.83	137.05.44	45.25	048.97	156.00.10
45.29	049.77	137.17.13	45.22	048.98	156.12.25
45.27	049.79	137.20.45	45.15	048.96	156.23.46
45.30	049.81	138.05.32	45.16	049.04	157.10.22
45.26	049.88	138.17.02	45.17	049.07	157.16.44
45.23	049.90	138.22.0[illegible]	45.18	049.03	157.23.26
45.19	049.88	139.05.20	45.14	049.04	158.10.00
45.18	049.91	139.16.53	45.15	049.16	158.19.5[illegible]
45.15	049.89	139.20.13	45.16	049.16	158.22.57
45.15	049.88	140.06.46	45.22	049.21	159.0[illegible].21
45.14	049.83	140.16.39	45.24	049.0[illegible]	159.22.43
45.13	049.79	140.21.20	45.25	049.05	160.0[illegible]
45.19	049.76	141.06.49	45.24	049.01	160.15.1[illegible]
45.21	049.74	141.12.49	45.23	048.93	160.23.5[illegible]
45.27	049.66	141.20.53	45.22	048.96	161.07.5[illegible]
45.16	049.70	142.06.2[illegible]	45.21	048.89	161.15.35
45.12	049.71	142.17.53	45.22	048.87	161.23.35
45.09	049.68	142.22.16	45.18	048.85	162.09.21
45.11	049.69	143.06.15	45.10	048.89	162.17.31
45.13	049.62	143.17.43	45.12	048.93	162.23.17
45.16	049.62	143.21.54	45.05	048.95	163.09.10
45.25	049.66	144.05.04	45.05	048.92	163.18.59
45.33	049.62	144.13.25	45.04	048.91	163.22.45
45.34	049.62	144.21.33	44.92	048.96	164.11.[illegible]
45.42	049.57	145.05.53	44.86	048.93	164.19.53
45.50	049.52	145.17.25	44.82	048.94	164.22.32
45.53	049.43	145.21.04	44.70	048.87	165.10.47
45.56	049.44	146.05.41	44.57	048.86	165.1[illegible].41
45.62	049.31	146.17.14	44.50	048.66	165.23.[illegible]
45.64	049.20	146.20.40	44.35	048.81	166.1[illegible].34
45.65	049.21	147.10.43	44.26	048.76	166.20.57
45.62	049.23	147.17.03	44.20	048.7[illegible]	166.23.28
45.60	049.23	147.22.15	44.11	048.73	167.09.56

LAT	LON	DTG
44.09	048.68	167.19.59
44.08	048.65	167.23.07
44.13	048.53	168.11.22
44.16	048.48	168.16.24
44.22	048.49	168.22.37
44.34	048.32	169.09.44
44.42	048.29	169.16.13
44.45	048.26	169.20.35
44.55	048.27	170.07.53
44.68	048.24	170.17.42
44.74	048.15	170.23.41
44.84	048.01	171.09.23
44.83	047.97	171.15.52
44.93	047.93	171.23.19
44.98	047.96	172.09.13
45.07	047.78	172.17.21
45.10	047.72	172.22.51
45.20	047.51	173.11.12
45.22	047.39	173.18.52
45.24	047.33	174.00.13
45.33	047.29	174.10.49
45.38	047.27	174.17.00
45.44	047.22	174.23.52

LAT	LON	DTG
45.48	047.16	175.08.41
45.49	046.96	176.21.24
45.49	046.95	176.23.09
45.43	046.92	177.13.01
45.39	046.97	177.19.45
45.24	046.93	178.11.00
45.21	046.89	178.17.54
45.15	046.85	179.00.05
45.10	046.66	180.09.22
45.17	046.65	180.15.50
45.27	046.65	180.23.18
45.37	046.64	181.09.08
45.39	046.64	181.19.02
45.39	046.46	182.09.30
45.37	046.39	182.18.52
45.38	046.30	183.10.51
45.43	046.26	183.16.59
45.48	046.19	183.23.47
45.51	046.15	184.10.29
45.50	046.11	184.16.39
45.46	046.10	184.23.33
45.46	046.04	185.05.17
45.41	046.01	185.13.15
45.41	045.94	185.22.57

TABLE 2c. BTT 2832 POSITIONS

LAT	LON	DTG
49.07	050.66	089.21.37
49.09	050.59	090.09.25
49.11	050.55	090.15.59
49.09	050.53	090.22.55
49.10	050.49	091.05.53
49.11	050.46	091.12.43
49.12	050.43	091.19.04
49.11	050.43	092.00.09
49.09	050.39	092.09.06
49.07	050.34	092.15.34
49.06	050.34	092.23.45
49.01	050.26	093.10.24
48.99	050.18	093.17.06
48.92	050.13	093.23.30
48.85	050.07	094.10.21
48.79	050.01	094.16.51
48.76	049.99	094.23.08
48.70	049.94	095.09.37
48.70	049.90	095.16.43
48.67	049.84	095.22.43
48.66	049.79	096.06.40
48.61	049.71	096.16.32
48.59	049.69	097.00.03
48.58	049.62	097.06.27
48.56	049.50	097.13.53
48.53	049.41	097.20.18
48.47	049.29	098.09.37
48.40	049.27	098.16.09
48.34	049.19	098.23.20
48.26	049.11	099.06.06
48.14	048.98	099.13.12
48.06	048.82	099.19.19
47.96	048.40	100.09.27
47.89	048.21	100.17.29
47.84	048.09	101.00.15
47.78	047.92	101.09.04
47.70	047.83	101.15.34
47.59	047.73	101.23.54
47.42	047.57	102.10.27
47.34	047.44	102.17.05
47.22	047.32	102.23.32
47.02	047.14	103.13.15
46.84	047.10	103.22.57
46.51	046.84	104.11.16
46.07	047.36	105.12.32
45.89	047.60	105.23.51
45.79	047.74	106.06.32
45.67	047.91	106.16.18
45.58	048.06	106.23.45
45.52	048.11	107.06.20
45.42	048.24	107.13.35
45.32	048.31	107.23.23
45.28	048.42	108.06.09
45.21	048.42	108.13.15
45.19	048.50	108.19.15
45.10	048.55	109.05.57
45.10	048.55	109.05.57
45.07	048.56	109.12.54
45.02	048.62	109.19.08
44.92	048.67	110.05.41
44.98	048.62	110.12.34
44.85	048.69	110.18.57
44.79	048.73	111.05.33
44.73	048.73	111.12.11
44.65	048.74	111.18.46
44.53	048.80	112.05.21
44.45	048.80	112.11.50
44.34	048.81	112.18.35
44.09	048.86	113.09.45
43.91	048.93	113.18.24
43.54	049.12	114.12.42
43.40	049.18	114.20.49
43.21	049.26	115.06.33
43.07	049.43	115.16.19
43.02	049.60	115.23.47
42.98	049.80	116.06.17
42.96	049.98	116.13.39
42.93	050.12	116.21.42
42.91	050.26	117.06.08
42.92	050.31	117.13.14
42.91	050.38	117.21.23
42.87	050.47	118.09.36
42.86	050.49	118.17.24
42.86	050.53	119.00.19
42.81	050.58	119.10.51
42.80	050.58	119.17.08
42.77	050.61	119.23.59
42.72	050.68	120.10.35
42.68	050.70	120.17.03
42.63	050.78	120.23.37
42.61	050.90	121.10.11
42.60	050.97	121.16.47
42.72	051.09	122.13.09
42.76	051.03	122.20.03
42.77	051.02	122.22.50
42.79	051.00	123.06.41
42.82	050.97	123.12.49
42.80	050.88	123.20.51
42.75	050.83	124.10.48
42.73	050.82	124.16.17
42.68	050.80	124.23.50
42.61	050.88	125.10.24
42.57	050.93	125.17.44
42.55	050.97	125.23.29
42.52	051.08	126.06.09
42.56	051.14	126.13.20
42.61	051.21	126.21.36
42.68	051.24	127.05.57
42.75	051.23	127.13.01
42.81	051.17	127.21.03

LAT	LON	DTG
42.84	051.12	128.10.53
42.84	051.07	128.17.15
42.82	051.03	128.20.40
42.77	051.01	129.05.33
42.69	051.01	129.13.54
42.62	051.05	129.22.01
42.55	051.19	130.10.14
42.54	051.26	130.16.46
42.56	051.34	130.23.19
42.67	051.43	131.08.34
42.79	051.44	131.16.40
42.89	051.38	131.22.58
42.96	051.27	132.06.44
42.96	051.17	132.16.25
42.97	051.09	132.20.55
42.88	050.99	133.06.32
42.86	050.98	133.12.30
42.75	050.98	133.22.13
42.62	051.09	134.10.28
42.53	051.17	134.17.48
42.46	051.29	134.23.31
42.43	051.44	135.10.06
42.41	051.52	135.17.37
42.44	051.58	135.23.09
42.51	051.65	136.11.19
42.58	051.68	136.17.19
42.63	051.69	136.21.07
42.86	051.66	137.11.04
42.97	051.65	137.17.08
43.03	051.60	137.20.44
43.20	051.53	138.10.40
43.22	051.48	138.17.02
43.22	051.48	138.20.20
43.24	051.39	139.10.16
43.23	051.37	139.16.48
43.23	051.49	139.22.03
43.16	051.24	140.06.50
43.09	051.15	140.16.40
43.05	051.09	140.23.00
43.00	051.06	141.06.41
42.95	051.03	141.12.55
42.88	051.01	141.20.57
42.77	051.09	142.06.31
42.67	051.17	142.12.29
42.57	051.29	142.22.15
42.49	051.49	143.08.00
42.49	051.62	143.17.48
42.53	051.69	143.23.33
42.62	051.72	144.07.50
42.65	051.73	144.13.27
42.75	051.80	144.21.31
42.94	051.74	145.11.21
43.02	051.72	145.17.25
43.06	051.68	145.22.47
43.08	051.62	146.11.05
43.07	051.59	146.17.07
43.05	051.58	146.20.46
43.00	051.62	147.10.43
42.96	051.69	147.17.02
42.98	051.76	147.22.06
43.03	051.84	148.06.45
43.14	051.89	148.16.51
43.25	051.91	148.23.24
43.39	051.93	149.09.57
43.49	051.94	149.16.39
43.52	051.94	149.22.56
43.60	052.00	150.06.41
43.63	052.01	150.12.56
43.67	052.08	150.19.45
43.71	052.12	151.00.20
43.78	052.28	151.17.59
43.79	052.32	151.23.58
43.79	052.42	152.06.18
43.83	052.59	152.16.05
43.84	052.71	152.23.36
43.89	052.89	153.10.04
43.90	053.00	153.17.29
43.93	053.10	153.23.14
43.93	053.23	154.09.44
43.89	053.32	154.17.25
43.86	053.32	154.21.12
43.82	053.32	155.00.31
43.67	053.29	155.11.09
43.47	053.17	155.22.30
43.28	053.01	156.10.38
43.18	052.93	156.16.56
43.10	052.84	156.22.09
42.93	052.66	157.10.23
42.86	052.55	157.16.45
42.78	052.43	157.23.26
42.69	052.33	158.08.32
42.63	052.28	158.13.20
42.49	052.19	158.21.24
42.27	052.09	159.11.20
42.19	052.05	159.16.22
42.12	052.02	159.20.58
41.97	051.92	160.08.10
41.87	051.82	160.16.14
41.82	051.75	160.22.19
41.74	051.62	161.07.58
41.73	051.54	161.13.47
41.67	051.47	161.21.52
41.61	051.34	162.10.13
41.57	051.26	162.17.34
41.55	051.19	162.23.16
41.51	051.08	163.09.13
41.48	051.03	163.13.11
41.44	050.95	163.21.11
41.35	050.79	164.11.09
41.29	050.67	164.17.10
41.23	050.01	164.20.50
41.07	050.35	165.10.43
40.95	050.15	165.18.40
40.89	050.03	165.23.49
40.76	049.77	166.10.24
40.73	049.62	166.16.48
40.75	049.49	166.23.27
40.83	049.41	167.09.59

LAT	LON	DTG	LAT	LON	DTG
40.90	049.39	167.16.33	43.02	051.02	176.21.25
41.01	049.41	167.23.03	43.03	051.05	177.06.20
41.18	049.39	168.09.35	43.05	051.10	177.16.23
41.29	049.39	168.16.24	43.07	051.13	177.22.46
41.40	049.35	168.22.43	43.09	051.18	178.11.00
41.61	049.24	169.11.01	43.10	051.21	178.17.55
41.68	049.20	169.17.50	43.13	051.22	179.00.05
41.72	049.20	169.20.39	43.24	051.35	180.04.24
41.84	049.30	170.07.59	43.25	051.39	180.17.33
41.90	049.39	170.12.16	43.26	051.42	190.23.15
41.99	049.57	170.19.21	43.30	051.50	181.09.10
42.16	049.71	171.07.48	43.31	051.56	181.18.58
42.24	049.88	171.13.32	43.34	051.63	182.00.37
42.38	050.00	171.21.38	43.35	051.68	182.11.13
42.55	050.13	172.09.14	43.40	051.73	182.16.51
42.65	050.19	172.17.22	43.40	051.78	183.00.14
42.70	050.24	173.00.34	43.43	051.83	183.08.47
42.75	050.31	173.09.26	43.47	051.86	183.16.58
42.78	050.40	173.17.10	43.48	051.94	183.23.55
42.83	050.58	174.10.45	43.56	051.94	184.10.29
42.86	050.64	174.17.00	43.56	052.01	184.16.47
42.87	050.70	174.23.51	43.63	052.02	184.23.33
42.91	050.80	175.10.28	43.74	052.03	186.12.55

TABLE 2d. BTT 2634 POSITIONS

LAT	LON	DTG
50.16	052.00	120.20.16
50.18	052.00	121.10.21
50.16	052.00	121.16.45
50.17	052.00	121.23.18
50.15	052.07	122.09.47
50.12	052.09	122.19.57
50.11	052.11	122.22.47
50.12	052.15	123.06.40
50.12	052.16	123.12.48
50.13	052.20	123.20.52
50.17	052.22	124.09.44
50.19	052.21	124.16.15
50.21	052.26	124.23.46
50.24	052.28	125.09.36
50.25	052.30	125.16.02
50.25	052.34	125.23.31
50.26	052.38	126.06.01
50.27	052.39	126.13.21
50.26	052.43	126.21.19
50.30	052.43	127.05.53
50.30	052.47	127.12.56
50.33	052.49	127.19.02
50.33	052.59	128.10.52
50.31	052.61	128.17.15
50.29	052.61	129.00.05
50.29	052.57	129.10.36
50.34	052.54	129.18.42
50.30	052.52	130.05.14
50.29	052.50	130.13.29
50.28	052.53	130.20.09
50.30	052.54	131.09.44
50.35	052.52	131.20.04
50.44	052.48	132.06.35
50.43	052.46	132.12.51
50.47	052.52	132.19.53
50.45	052.50	133.06.26
50.51	052.52	133.12.24
50.43	052.53	133.21.29
50.54	052.53	134.06.15
50.53	052.53	134.13.42
50.55	052.51	134.21.53
50.56	052.43	135.06.05
50.59	052.43	135.13.23
50.53	052.47	135.21.30
50.58	052.46	136.04.13
50.59	052.50	136.15.45
50.54	052.47	136.22.48
50.52	052.48	137.05.41
50.52	052.47	137.12.37
50.50	052.44	137.18.54
50.54	052.43	138.05.35
50.51	052.44	138.12.2[illegible]
50.54	052.40	138.20.24
50.55	052.40	139.05.14
50.55	052.34	139.13.31
50.56	052.33	139.19.59
50.58	052.29	140.06.52
50.58	052.31	140.11.29
50.62	052.27	140.20.04
50.65	052.24	141.06.34
50.65	052.17	141.12.51
50.61	052.23	141.20.59
50.62	052.44	142.06.29
50.62	052.26	142.12.31
50.65	052.24	142.19.40
50.69	052.23	143.06.17
50.71	052.21	143.13.47
50.72	052.19	143.20.14
50.74	052.19	144.05.01
50.77	052.19	144.13.24
50.80	052.25	144.19.49
50.87	052.23	145.05.53
50.89	052.24	145.13.05
50.95	052.24	145.19.17
51.00	052.23	146.12.44
51.00	052.26	146.18.56
51.05	052.32	147.10.41
51.06	052.34	147.16.55
51.09	052.40	148.10.17
51.08	052.39	148.16.54
51.09	052.43	148.23.22
51.07	052.44	149.09.54
51.09	052.48	149.16.42
51.09	052.47	149.23.05
51.09	052.51	150.06.34
51.09	052.48	150.12.55
51.08	052.51	150.19.51
51.09	052.51	150.22.32
51.10	052.53	151.10.47
51.12	052.52	151.17.51
51.12	052.53	151.20.35
51.15	052.55	152.06.11
51.15	052.52	152.13.44
51.18	052.52	152.23.32
51.20	052.53	153.09.20
51.23	052.52	153.19.19
51.23	052.52	153.23.16
51.27	052.53	154.06.47
51.27	052.51	154.11.14
51.31	052.52	154.21.10
51.35	052.53	155.11.00
51.35	052.53	155.12.44
51.36	052.55	155.15.34
51.41	052.60	156.10.24
51.44	052.58	156.18.44
51.43	052.58	156.23.59
51.44	052.56	157.10.15
51.45	052.56	157.20.07
51.45	052.55	157.23.29
51.45	052.56	158.10.06

LAT	LON	DTG
51.46	052.55	158.21.22
51.46	052.54	158.23.07
51.48	052.54	159.09.56
51.50	052.59	159.19.51
51.51	052.58	159.22.45
51.54	052.57	160.09.47
51.54	052.56	160.16.17
51.54	052.55	160.20.41
51.57	052.54	161.09.32
51.59	052.57	161.17.46
51.63	052.51	161.23.41
51.64	052.52	162.09.20
51.66	052.42	162.17.37
51.67	052.50	162.23.16
51.70	052.41	163.09.06
51.73	052.45	163.19.33
51.73	052.41	163.22.54
51.74	052.38	164.11.03
51.71	052.31	164.17.09
51.71	052.36	164.20.53
51.73	052.28	165.10.42
51.75	052.26	165.16.56
51.73	052.23	165.23.52
51.75	052.14	166.13.42
51.73	052.14	166.16.51
51.76	052.16	166.23.31
51.72	052.11	167.10.00
51.78	052.10	167.16.40
51.72	052.07	167.23.08
51.76	052.04	168.09.55
51.75	052.17	168.19.47
51.77	052.13	168.22.46
51.75	052.14	169.09.42
51.72	052.17	169.17.59
51.72	052.15	169.20.39
51.72	052.10	170.09.32
51.74	052.08	170.17.44
51.73	052.05	170.21.57

LAT	LON	DTG
51.74	052.01	171.09.2[illegible]
51.72	051.99	171.17.33
51.72	051.95	171.23.2[illegible]
51.69	051.94	172.09.07
51.67	051.90	172.17.21
51.66	051.91	172.22.[illegible]
51.61	051.88	173.10.34
51.59	051.85	173.17.13
51.51	051.83	173.22.32
51.55	051.78	174.10.46
51.54	051.71	174.16.5[illegible]
51.53	051.64	174.23.5[illegible]
51.53	051.47	175.10.21
51.53	050.83	176.23.04
51.53	050.79	177.00.4[illegible]
51.53	050.72	177.09.54
51.46	050.61	177.19.48
51.45	050.55	178.00.27
51.32	050.44	178.10.59
51.30	050.45	178.17.57
51.16	050.46	179.09.31
50.93	050.59	180.09.22
50.96	050.64	180.17.32
50.91	050.66	180.23.22
50.87	050.71	181.09.04
50.79	050.72	181.19.[illegible]
50.69	050.68	182.09.2[illegible]
50.61	050.62	182.16.49
50.57	050.56	183.00.18
50.50	050.47	183.10.46
50.45	050.45	183.17.00
50.42	050.43	183.23.[illegible]
50.31	050.38	184.1[illegible].[illegible]
50.26	050.37	184.16.44
50.19	050.36	184.[illegible]
50.08	050.34	185.13.1[illegible]
50.05	050.39	185.[illegible]

TABLE 2a. BTT 2813 POSITIONS

LAT	LON	DTG
50.24	050.46	149.20.03
50.27	050.46	149.21.22
50.29	050.35	150.06.39
50.31	050.34	150.12.55
50.34	050.40	150.22.42
50.32	050.48	151.10.47
50.29	050.49	151.16.14
50.23	050.47	151.20.36
50.16	050.37	152.06.16
50.11	050.25	152.16.03
50.10	050.18	152.23.34
50.11	050.15	153.06.02
50.14	050.13	153.15.51
50.17	050.15	153.23.17
50.19	050.21	154.05.49
50.18	050.26	154.15.45
50.19	050.30	154.21.09
50.13	050.31	155.09.10
50.18	050.36	155.12.46
50.13	050.41	155.22.27
50.16	050.43	156.10.39
50.14	050.46	156.16.59
50.12	050.46	156.23.59
50.09	050.47	157.10.21
50.05	050.46	157.18.34
50.04	050.48	157.23.29
50.00	050.47	158.10.07
49.95	050.44	158.19.43
49.95	050.43	158.23.06
49.91	050.45	159.09.53
49.90	050.46	159.19.49
49.89	050.43	159.22.35
49.87	050.42	160.09.47
49.87	050.40	160.16.18
49.86	050.40	160.20.41
49.85	050.36	161.09.32
49.82	050.34	161.17.48
49.84	050.29	161.23.33
49.84	050.22	162.09.22
49.84	050.14	162.19.17
49.85	050.13	162.23.09
49.88	050.10	163.09.06
49.89	050.09	163.19.05
49.90	050.10	163.22.55
49.93	050.14	164.11.08
49.95	050.19	164.18.50
49.97	050.22	164.22.33
49.98	050.34	165.10.45
49.94	050.41	165.18.36
49.92	050.45	165.23.52
49.85	050.50	166.10.18
49.79	050.46	166.20.08
49.78	050.50	166.23.30
49.75	050.42	167.10.00
49.76	050.36	167.20.01
49.77	050.36	167.23.02
49.82	050.32	168.09.55
49.85	050.28	168.16.23
49.85	050.30	168.22.43
49.89	050.23	169.09.37
49.84	050.31	169.16.15
49.86	050.32	169.20.34
49.85	050.30	170.09.34
49.87	050.30	170.19.27
49.85	050.34	170.22.01
49.89	050.43	171.09.20
49.88	050.60	171.19.15
49.87	050.59	171.23.16
49.79	050.68	172.09.13
49.70	050.70	172.19.05
49.67	050.70	172.22.59
49.58	050.60	173.11.11
49.57	050.52	173.18.53
49.57	050.46	173.22.35
49.58	050.44	174.00.15
49.63	050.35	174.16.57
49.58	050.36	174.23.55
49.71	050.44	175.10.25
49.57	050.70	176.19.48
49.53	050.66	177.09.54
49.52	050.59	177.16.27
49.49	050.51	177.22.49
49.46	050.37	178.10.58
49.44	050.28	176.17.50
49.44	050.22	179.00.05
49.43	050.10	179.09.27
49.49	050.11	180.09.21
49.50	050.07	180.15.44
49.49	050.10	180.21.41
49.51	050.96	181.09.09
49.51	050.04	181.19.04
49.49	050.06	182.00.39
49.48	050.01	182.09.26
49.43	049.98	182.18.51
49.40	049.97	183.00.18
49.32	049.94	183.10.49
49.27	049.90	183.16.56
49.20	049.89	183.23.50
49.09	049.81	184.10.28
49.00	049.77	184.16.49
48.92	049.67	184.23.31
48.82	049.57	185.08.17
48.76	049.48	185.13.15
48.68	049.42	185.22.57

TABLE 21. BTT 2636 POSITIONS

LAT	LON	DTG
48.85	050.42	150.00.42
48.82	050.29	150.11.15
48.72	050.25	150.22.36
48.64	050.22	151.10.47
48.64	050.18	151.16.14
48.58	050.22	151.23.59
48.57	050.21	152.09.35
48.56	050.26	152.17.49
48.57	050.29	152.23.38
48.58	050.30	153.06.05
48.61	050.38	153.17.37
48.60	050.44	153.23.36
48.63	050.47	154.05.51
48.64	050.51	154.15.44
48.66	050.51	154.21.09
48.66	050.52	155.09.33
48.68	050.49	155.11.06
48.68	050.48	155.12.45
48.70	050.41	156.10.44
48.70	050.41	156.17.04
48.71	050.37	156.23.49
48.73	050.34	157.10.19
48.72	050.32	157.16.52
48.71	050.28	157.23.28
48.71	050.20	158.10.06
48.68	050.17	158.20.02
48.62	050.14	159.09.54
48.62	050.09	159.19.47
48.61	050.07	159.22.41
48.62	050.01	160.04.46
48.52	049.99	160.10.52
48.58	049.93	160.20.41
48.54	049.81	161.07.58
48.53	049.71	161.16.05
48.49	049.61	161.23.39
48.46	049.44	162.09.22
48.41	049.35	162.14.12
48.39	049.30	162.23.12
48.35	049.20	163.09.09
48.31	049.07	163.19.03
48.29	049.03	163.22.56
48.25	048.92	164.11.09
48.22	048.87	164.19.54
48.22	048.84	164.22.31
48.16	048.75	165.10.46
48.14	048.70	165.17.00
48.12	048.65	165.23.51
48.09	048.53	166.10.19
48.07	048.46	166.16.46

LAT	LON	DTG
48.05	048.37	166.23.27
48.03	048.26	167.10.00
48.01	048.19	167.16.39
48.01	048.14	167.23.07
48.02	048.00	168.09.55
47.93	047.94	168.16.26
47.94	047.87	168.22.45
47.96	047.75	169.09.44
47.92	047.67	169.12.34
47.85	047.69	169.20.43
47.83	047.59	170.09.32
47.83	047.59	170.13.52
47.82	047.49	170.20.21
47.80	047.45	171.09.20
47.72	047.39	171.19.13
47.74	047.39	171.23.19
47.65	047.29	172.09.09
47.68	047.26	172.17.19
47.62	047.16	172.22.54
47.55	047.15	173.11.07
47.45	047.14	173.17.03
47.43	047.18	173.22.33
47.29	047.14	174.10.43
47.27	047.15	174.17.00
47.17	047.10	174.23.53
47.08	047.11	175.10.25
46.65	047.06	176.19.45
46.52	047.00	177.09.54
46.45	047.02	177.16.25
46.42	047.01	177.22.48
46.34	047.06	178.09.17
46.26	047.09	178.17.54
46.24	047.14	179.00.03
45.99	047.45	180.09.21
45.96	047.49	180.15.40
45.89	047.55	180.23.14
45.80	047.63	181.09.10
45.73	047.71	181.19.01
45.60	047.87	182.11.12
45.56	047.96	182.18.51
45.50	048.02	183.00.16
45.42	048.14	183.10.45
45.40	048.22	183.16.48
45.32	048.24	183.23.54
45.24	048.37	184.10.29
45.15	048.43	184.16.41
45.10	048.46	184.23.33
44.93	048.54	185.13.15
44.86	048.60	185.22.57

TABLE 2g. BTT 2633 POSITIONS

LAT	LON	DTG
51.78	054.90	161.16.02
51.79	054.91	161.20.17
51.79	054.86	161.23.41
51.78	054.88	162.09.22
51.79	054.81	162.17.37
51.81	054.82	162.23.16
51.81	054.73	163.09.05
51.83	054.72	163.19.07
51.81	054.69	163.22.57
51.80	054.70	164.00.36
51.77	054.64	164.14.23
51.76	054.65	164.20.52
51.77	054.63	165.00.13
51.69	054.55	165.17.03
51.64	054.53	165.23.50
51.59	054.46	166.10.23
51.54	054.45	166.16.52
51.50	054.43	166.23.31
51.42	054.40	167.10.00
51.39	054.36	167.16.40
51.34	054.34	167.23.04
51.29	054.28	168.09.53
51.28	054.27	168.16.25
51.24	054.24	168.22.44
51.19	054.19	169.09.43
51.16	054.22	169.16.17
51.14	054.13	169.22.25
51.13	054.11	170.09.32
51.09	054.05	170.17.48
51.11	054.07	170.22.01
51.10	053.98	171.09.21
51.11	053.96	171.17.36
51.10	053.90	171.23.21

LAT	LON	DTG
51.12	053.87	172.09.14
51.10	053.80	172.15.43
51.12	053.76	172.22.54
51.08	053.66	173.10.38
51.07	053.62	173.17.12
51.02	053.56	174.10.47
50.98	053.53	174.17.01
50.99	053.51	174.23.47
50.94	053.49	175.10.23
50.89	053.49	176.21.25
50.87	053.47	177.00.49
50.85	053.51	177.09.54
50.83	053.48	177.16.27
50.79	053.50	177.22.49
50.76	053.51	178.10.59
50.74	053.54	178.17.51
50.68	053.58	179.09.30
50.61	053.73	180.09.23
50.61	053.79	180.15.53
50.58	053.85	180.23.28
50.58	053.93	181.09.06
50.55	053.96	181.19.05
50.55	054.01	182.00.39
50.55	054.02	182.12.46
50.56	054.02	182.18.52
50.60	054.04	183.10.49
50.59	054.02	183.17.01
50.60	054.03	183.23.50
50.60	054.00	184.10.27
50.60	053.98	184.16.49
50.60	053.94	184.23.31
50.56	053.90	185.13.15
50.54	053.89	185.22.57

APPENDIX C

PRELIMINARY REPORT
1980 IIP CRUISE
USCGC EVERGREEN

ICEBERG MOVEMENT STUDY

On 20 May 1980, USCGC EVERGREEN departed New London, CT, for the Grand Banks off Newfoundland. Several scientists were on board to carry out experiments designed to further our understanding of the drift and decay of icebergs. One experiment involved tracking an iceberg in order to develop better methods of predicting the movement of icebergs for periods of days to perhaps weeks. This report will examine the preliminary observations and results of that experiment.

EXPERIMENT

The iceberg movement study entailed tracking an iceberg while measurements were made of the wind speed and currents in the area. Wind speed was measured on board the EVERGREEN using an automated weather station which continually recorded wind direction and average hourly wind speed. Current measurement was accomplished using three windowshade drogues. One drogue measured near-surface current, a second drogue measured curents at 10 meters, and the last drogue measured currents at 100 meters depth. By obtaining measurements of current speed at these three depths, it is possible to obtain a rough estimate of the integrated velocity of the water column between the surface and one hundred meters. The current associated with this layer has a significant effect on the movement of icebergs.

During this cruise, four different icebergs were tracked for varying periods of time. As the icebergs were tracked, wind velocity and location of the iceberg and drogues were recorded every half hour. The amount of data collected was voluminous and will require many months for full analysis. Discussions with the project scientist (LT Tebeau) indictate that this data will be fully analyzed in the future in order to better our understanding of the effect of wind and currents on the movement of icebergs. The analysis of the data for this preliminary report focuses on the drift path of the iceberg over discreet periods of time and the effect of the wind on the drift path.

On 27 May 1980, the first iceberg to be tracked was sighted at approximately 49°35'N, 49°51'W. The drift of this iceberg was observed for two time periods. Figure 1 shows the movement of the iceberg for the first period on 27 and 28 May. Also shown on figure 1 is the movement of the shallow, mid-depth, and deep drogues as well as a progressive wind vector for this period. The tracklines shown on figure 1 are sometimes erratic, zigzagging back and forth. These fluctuations are caused by errors in positions of the ship which were sometimes determined from DR locations. When the half-hourly positions are analyzed and plotted, the track should appear smoother. In any case, for this analysis, the average movement of the drogues and bergs is important and will be discussed.

During the period 2000, 27 May, to 1830, 28 May, the iceberg moved 8.7 nautical miles in a direction of 98°30'T. The average wind velocity for this period was eight knots toward 004°T. The vectors for the three drogues for this period of time are given in table 1.

TABLE 1—MOVEMENT OF THE SHALLOW, MID-DEPTH, AND DEEP DROGUES FOR THE PERIOD 200, 27 MAY, TO 1830, 28 MAY

Shallow Drogue		Mid-Depth Drogue		Deep Drogue	
Direction	Distance (Naut. Mi.)	Direction	Distance (Naut. Mi.)	Direction	Distance (Naut. Mi.)
88°T	10.9	107°T	11.4	105°T	6.65

Using the simple assumption that the currents decay linearly with depth the integrated velocity for the drift period from the surface to 100 meters is 9.24 nautical miles at approximately 104 °T. These values when compared to the actual drift of the iceberg indicate that the iceberg was moving with the prevailing current and wind effects were negligible.

The second period that the iceberg was tracked was from 2100, 19 May 1980, to 0700, 1 June 1980 (figure 2). The movement of the drogues and the iceberg were all similar, towards the east till 1200 on 31 May, The wind during this initial period of drift was from the southeast veering to the northwest later in the period. Wind speed was generally light between 2 and 10 knots. Again, this movement indicates the iceberg was drifting with the current independent of the wind. After 1200 on 30 May, the situation changed dramatically. The wind speed increased to 15 to 20 knots from the northwest (figure 3). The drift of the berg suddenly veers to the south in response to this wind. Also, the surface drogue veers and moves in the same direction as the iceberg.

Figure 4 shows a smoothed graph of the wind speed and the increased speed of the iceberg caused by the wind. The mid-depth and deep drogues generally continue their movement towards the east. The speeds of the drogues change in response to the wind (figue 5) indicating some energy input into the ocean. However, this response is not as great as that shown by the iceberg. This indicates that the wind effect (leeway) on the iceberg increases dramatically when the winds are high (i.e., 10) knots) and from a constant direction.

A second iceberg was located on 7 June 1980. Release of the mid-depth and deep drogues and tracking of the iceberg commenced at 1100 on the 9th. The shallow drogue was tracked commencing at 1400. The drift patterns of the iceberg and drogues are very complicated. The wind direction for the period of 1100, 9 June, to 1500, 13 June, is consistently from the south and southwest. The winds were very strong during this period, averaging 15-20 knots with occasional episodes of 30 knots. The drogues for the first few hours move downwind (figure 6). However, after 1800 on the 9th of June, they veer towards the north and northeast, finally describing a large arc by the morning of 10 June. During the day on 10 June, their motion was chaotic until they were removed from the water on the afternoon of 10 June. The iceberg on the other hand, moved downwind from the initial tracking time till 1900 on the 11th. Similar to the second period of drift for the first iceberg, it appears that, during this episode of strong winds, the direction of movement of the iceberg is primarily controlled by the winds and not the currents. Generally, the currents indicated by the drogue movement were towards the east-southeast for the entire period of time the four icebergs were tracked. Unlike the first iceberg, however, the speed of the second iceberg never approached the maximum speed of the first (120cm/sec). This was probably caused by the wind being in general opposition to the current direction for the second iceberg drift where the wind direction and current direction were in the same direction for the first iceberg drift. The speed of movement of the iceberg with respect to wind direction is discussed later.

During the latter part of this tracking experiment, the drogues were again placed in the water. The movement of the drogues is not indicated on figure 6. However, the movement of the drogues was similar to the iceberg. After 2000 on 11 June, the iceberg and drogues commenced a looping pattern till tracking ceased on the 13 June. The winds were fairly strong (10-20 knots) during this period which indicates that inertial oscillations are not the explanation of this motion. Further detailed analysis of the data may indicate the reason for this erratic motion.

Two other icebergs were tracked, one on 14 and 15 June and the second on 16 and 17 June. These drift tracks are shown on figures 7 and 8. Again, for these drifts, the strong winds played a significant part in the movement of the icebergs. For the drift on 14 and 15 June, the wind speed was between eighteen and thirty knots throughout most of the period. The winds prior to 14 July were westerly and it appears the iceberg movement is in the direction of these winds. After 0900 on the 14th, the winds shifted to the southwest and the iceberg drift shifted more to the northeast. As the winds diminished after 1200 on the 15th, the iceberg track veers to the southeast in the direction of the currents.

The iceberg drift on 16-17 June is again dominated by the strong winds. Initially, the iceberg moves towards the north and then veers to the east and southeast as the wind veers to the west and northwest.

A comparison of the drift distance between the different icebergs shows the effect wind direction has on the iceberg drift. Figure 9 compares the drift distance with wind speed for three of the icebergs. Each data point represents a drift period of twenty-four hours. For the case where the wind is in the direction of the currents (assumed to be towards the southeast, based on the drogue data) the drift distance increases with wind speed. However, when the wind is 90° to the right of the current, the drift speed of the iceberg is less than that of the first

case as evidenced by the decrease in the drift distance during 15-knot winds. When the winds are opposite to the current, the decrease in total drift distance is amplified even more as shown in figure 9.

Summary

The analysis given is preliminary in nature. Further analysis is in progress and will perhaps assist in changing the qualitative information in this report to more quantitative results.

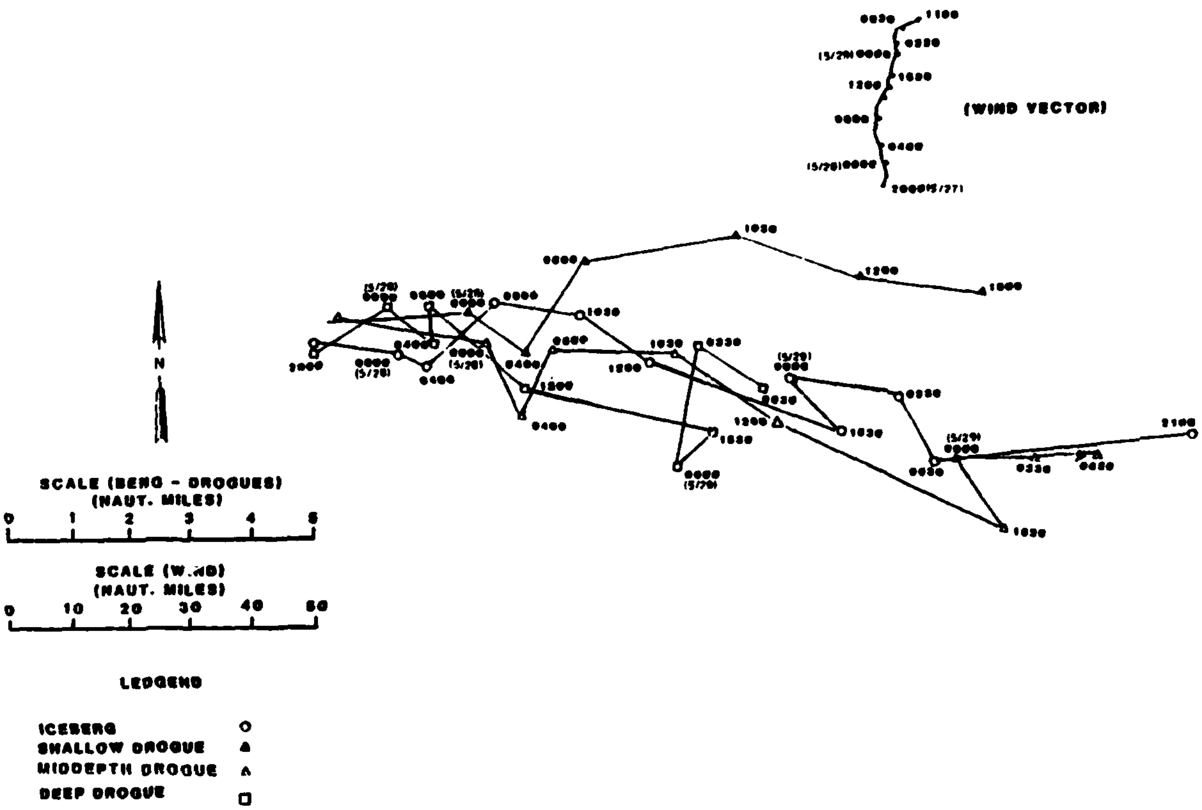


Figure 1.—Iceberg and drogue tracks for the period 27 to 28 May, 1980.

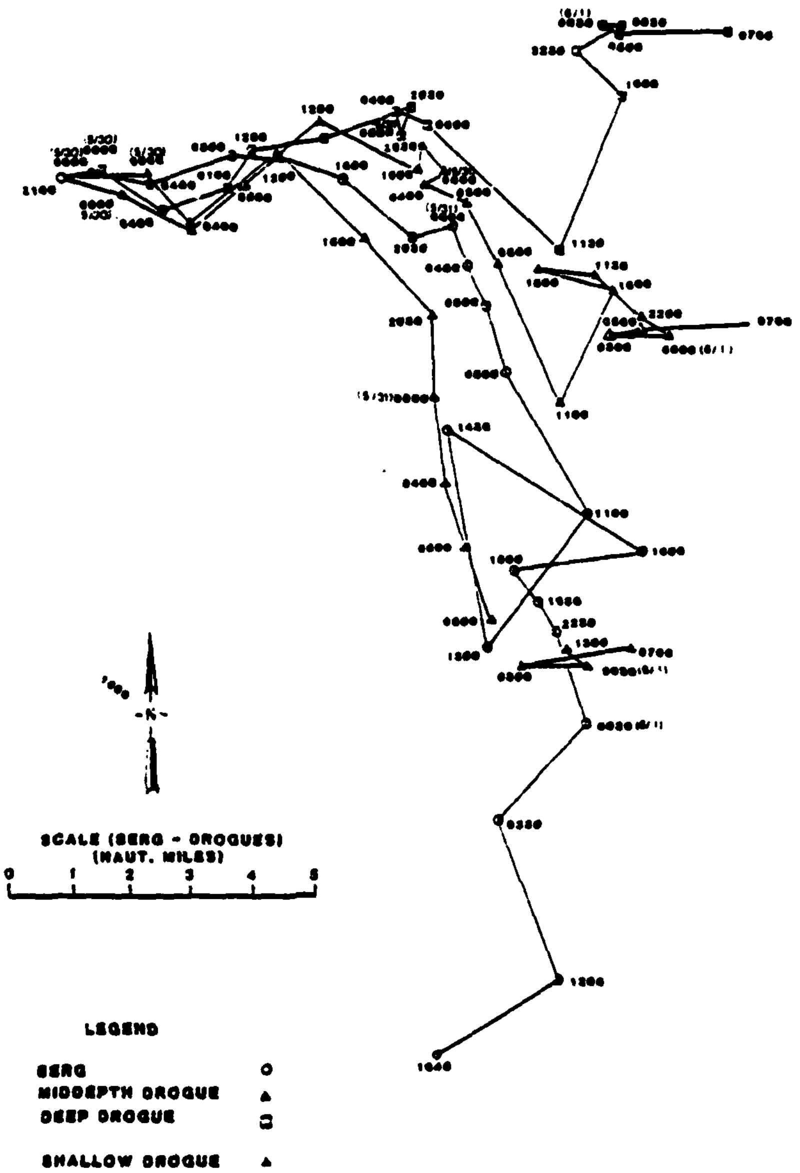


Figure 2.—Iceberg and drogue tracks for the period 29 May to 1 June 1980

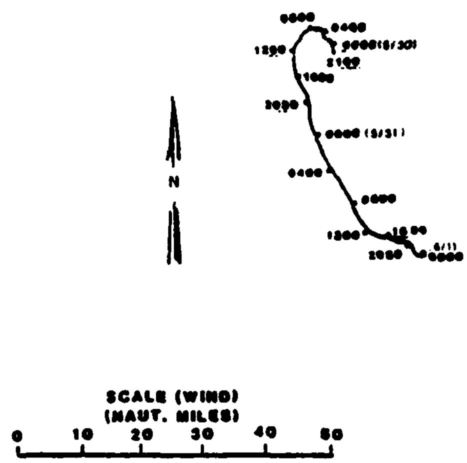


Figure 3.—Progressive wind vector for the period 2100, 29 May, to 2400, 31 May.

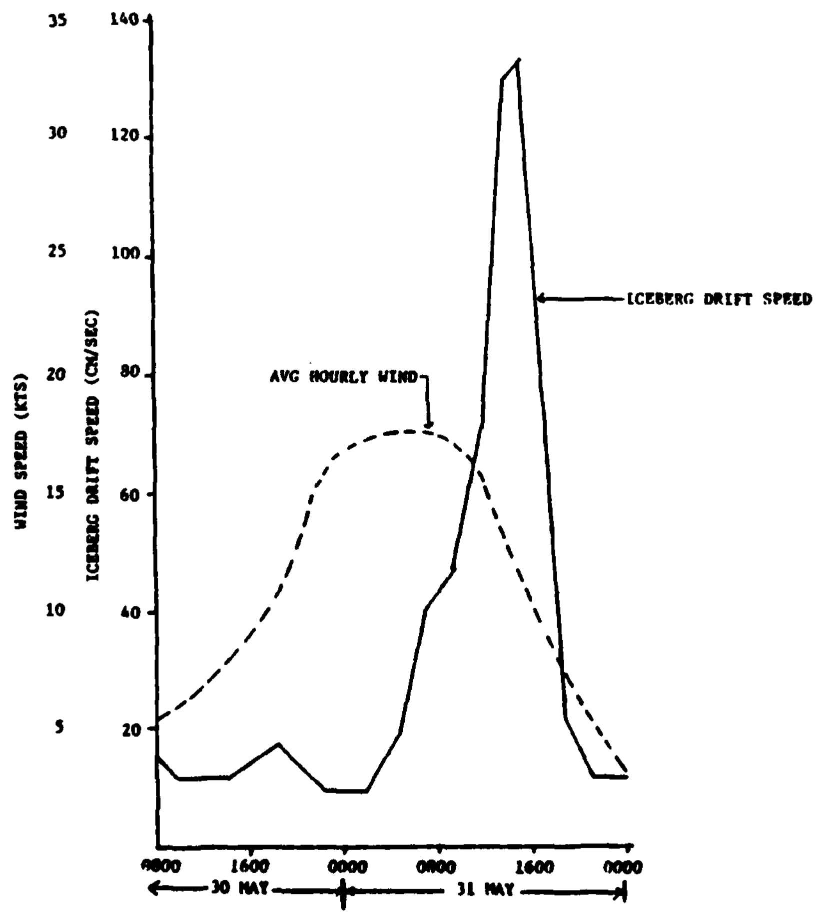


Figure 4.—Average hourly wind speed and iceberg drift speed for the period 0800, 30 May to 2400, 31 May 1980.

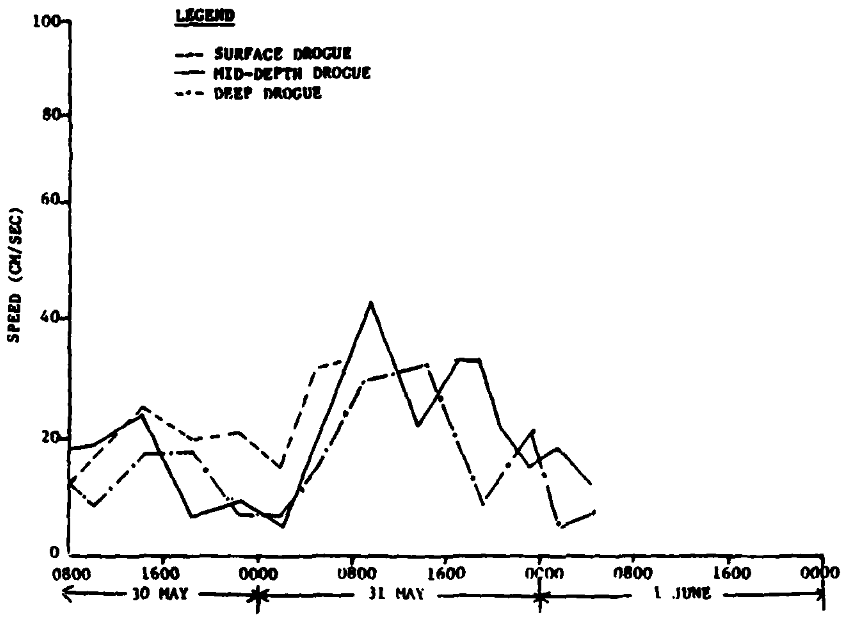


Figure 5.—Drift speeds of the surface, mid-depth and deep drogues for the period 0800, 30 May, to 0500, 1 June 1980.

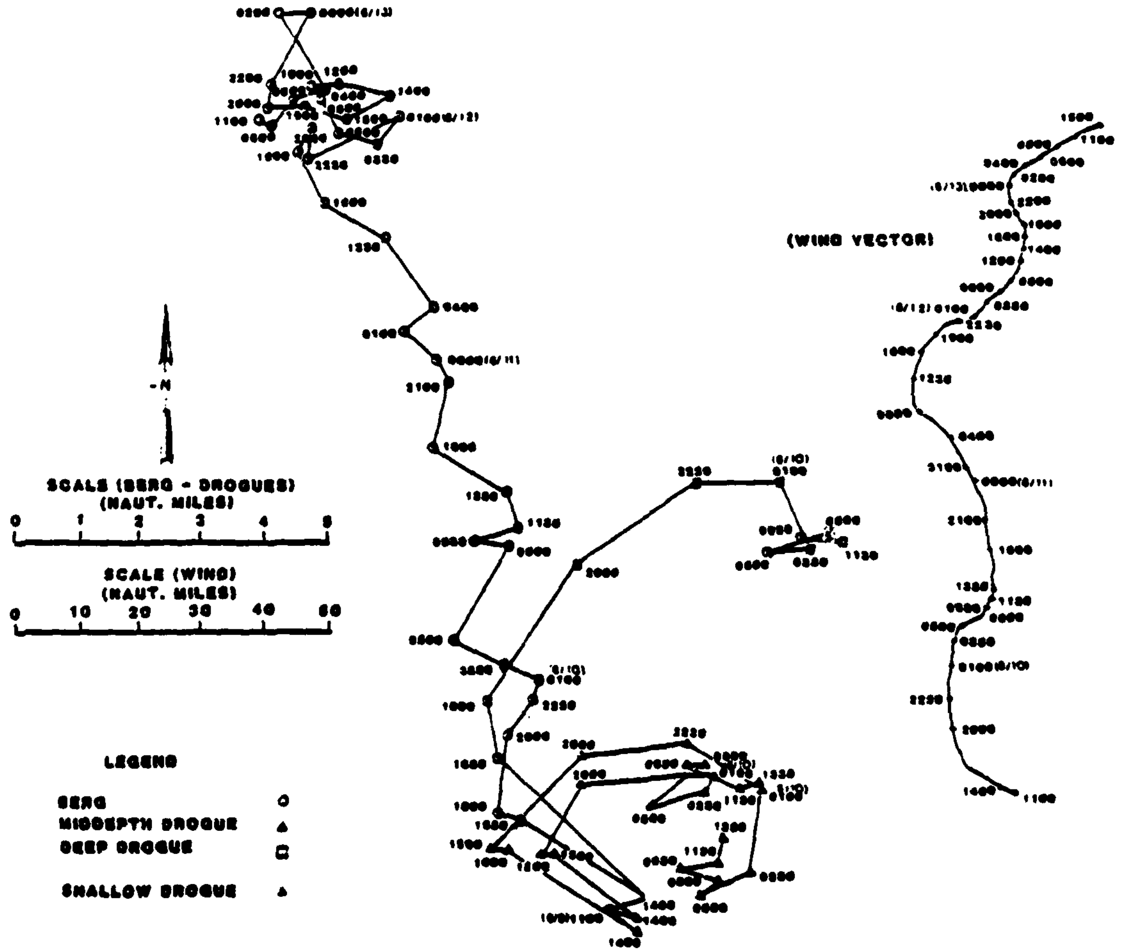


Figure 6.—Drift tracks of an iceberg and drogues for various time periods from 9 to 13 June 1980.

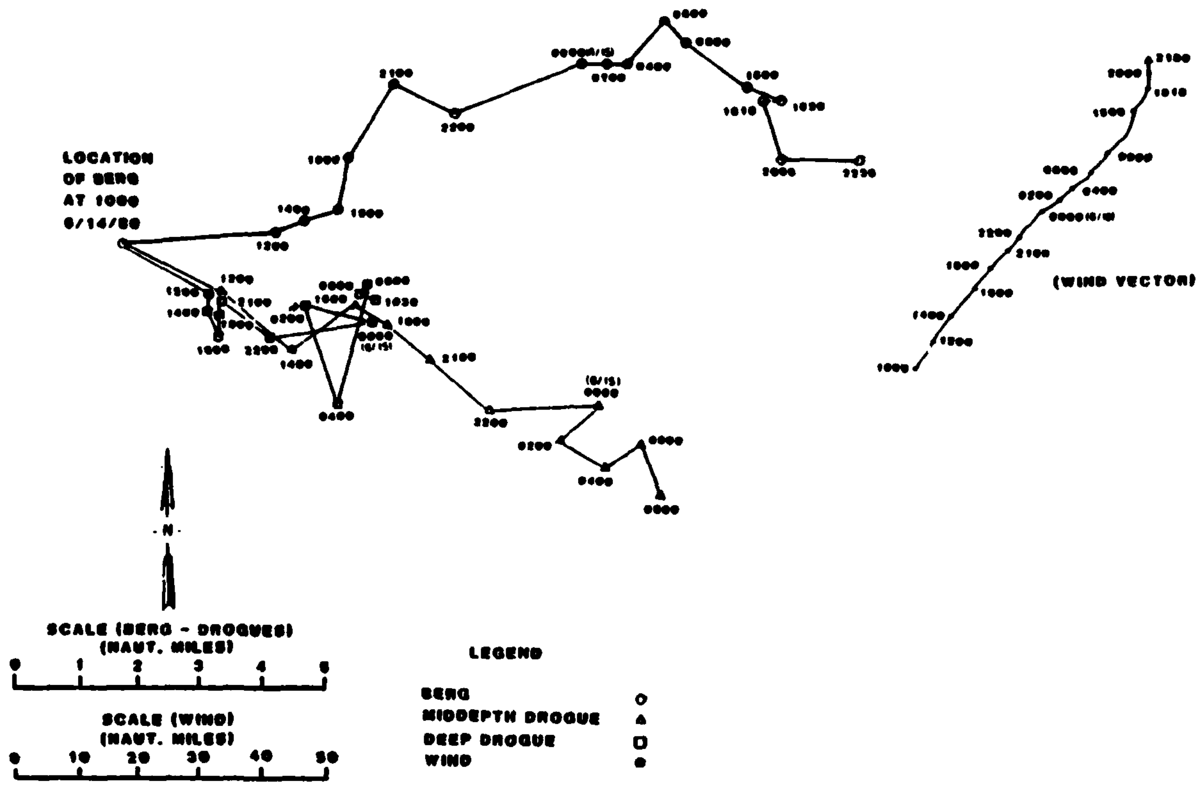


Figure 7.–Drift tracks of an iceberg and drogues for various time periods on 14 and 15 June, 1980.

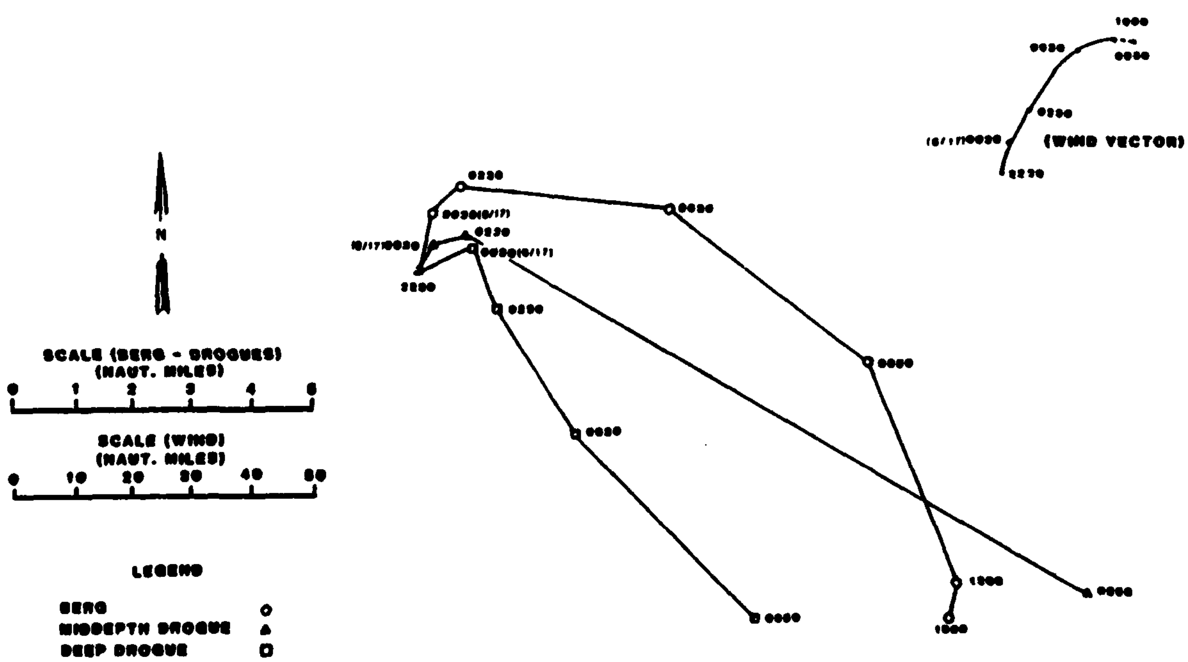


Figure 8.–Drift tracks of an iceberg and drogues for various time periods on 16 and 17 June, 1980.

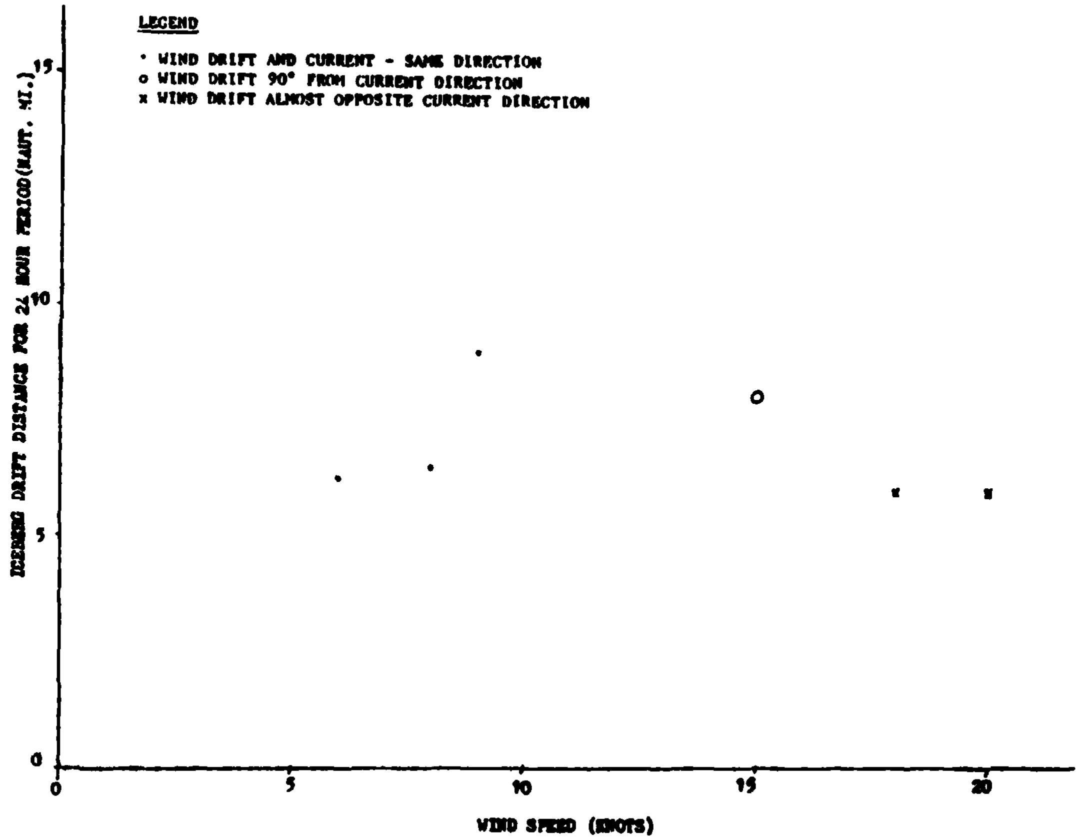


Figure 9.—Comparison of iceberg drift distance for winds which have varying directions from the current direction.

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